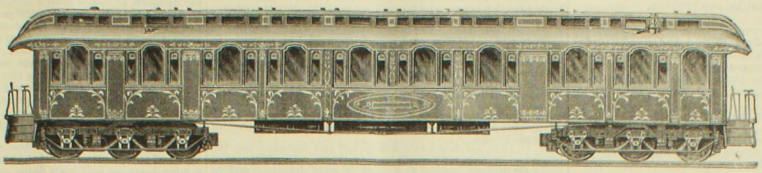
NATIONAL CAR AND LOCOMOTIVE BUILDER.



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Railway Machinery Exhibition at Liverpool.

[EDITORIAL CORRESPONDENCE.]

LIVERPOOL (ENG.), July, 1886.

Parties interested in the prosperity of this city arranged for an International Exhibition of Navigation, Traveling Commerce and Manufacturing Appliances, to be held here this summer, and the show is now open. The scheme of the exhibition embraced the exhibit of specimens of all devices used by mankind as artificial aids to locomotion. The departments relating to marine transportation are exceedingly well represented, but there are not so many appliances relative to land travel as might be expected, considering the magnitude of the interests. The railroad appliances are not numerous, but those shown are very interesting. It would be hard to select a city in Great Britain more appropriate for the holding of an exhibition of railway appliances, for the neighborhood of Liverpool may be regarded as the birthplace of the railway world. A run of forty-five minutes takes us over the whole Liverpool & Manchester Railway, the ground where Stephenson so vigorously fought for the cause of railroad transportation, and for the locomotive as a mode of motion.

The land transportation portion of the exhibition embraces devices ranging down from Webb's great compound locomotive, the "City of Liverpool," to the smallest form of baby carriage. Within the boundary of these extremes we observed many beautiful and elaborate forms of horse carriages, a multitude of divers forms of machines of the velocipede genus and interesting ancient or foreign elementary conveyances. Among the latter were sedan chairs that had really carried ladies fair of a remote generation, Chinese "Rickshaws" and hand litters that illustrate the primitive ways of getting through the world that are still clung to in the celestial empire, and numerous forms of litters carried in more or less precarious positions between festive mules, the latter in stuffed shape, showing how the cavalcade would look while the mule remained quiescent. How it would look when the quadruped began to indicate in his own peculiar fashion a desire to part with the burden, is left to the imagination. There are many ingeniously contrived ambulances, among them being one for railroad work. It is a portable frame into which a stretcher is suspended and held in position by spiral springs. Whatever direction a jar may come, it is received by free working springs. This ambulance would cost little, and could be carried conveniently on the floor of a baggage car. Its introduction into American roads would prevent considerable suffering in cases where injured persons have to be carried long distances to hospitals.

To us, the most interesting object in the exhibition was Mr. Webb's compound locomotive, the "City of Liverpool," built specially for the exhibition. The engine throughout is a triumph of workmanship and elaborate finish. She is of the latest type of compound, and is intended for the heavy main line through traffic. As most of our readers are aware, these locomotives have three cylinders, two high pressure cylinders for outside connection and one low pressure cylinder for inside connection. The outside cylinders are 14 inches, and the inside cylinder 30 inches diameter with a stroke of 24 inches. Provision is made to admit high pressure steam into the low pressure cylinder when starting. A duplex screw reversing gear is used on the engine, the expansion for both high and low pressure cylinders being regulated by one hand wheel. On the platform in front of the engine is an unfinished crank axle similar to that used, the purpose being to show the method of forming the crank, which is done by merely bending a straight axle in a powerful hydraulic press. The axle is of steel 9 inches diameter. The engine rests on a steel track with steel ties. The latter is another of Mr. Webb's inventions, and is simply an inverted trough with chairs for holding the rails riveted on top. A steel trough for holding water to be taken up while the engine is running extends beneath the engine and tender, and the latter is equipped with apparatus for catching the water. We were struck with the smallness of the tender compared to the capacity of the engine. The former holds 1,800 gallons of water and carries 5 tons of coal.

Sharp, Stewart & Co., of Manchester, exhibit a heavy suburban traffic engine that resembles a Forney engine with inside cylinders. Beyond the merit of excellent workmanship, there is nothing very notable about the engine.

In lingering round the place where most of the railway machinery was collected, we several times heard the railway men who congregated round there discussing the merits of the Yankee engine. Learning from the remarks that an American locomotive was exhibited in another portion of the building, we started in search of what we supposed would look like a friend in a strange land. Among an excellent display of traction locomotives we found a small metre-gauge tank engine, with a pilot at each end. It was an engine built by Black, Hawthorne & Co., for a narrow gauge railroad in Brazil, and at the first glance looked somewhat like some of the machines turned out by H. K. Porter & Co., of Pittsburgh. Close inspection, however, convinced us that the makers named would have scorned to be identified with the machine. Outside cylinders were used, and the hind end of the engine was carried on a four-wheel truck of nearly American pattern, but there the American features ended. Plate frames were used with no wedges or means of taking up lost motion. Many of the parts were proportioned very differently from American practice, with superfluous material where it could have been safely dispensed with, and deficiency of body where strength was badly needed. Yet it appeared to be settled by all and sundry that the engine was made after American designs in every particular.

The Lancashire & Yorkshire Railway exhibited a "composite" car, which was regarded all round as a wonderful triumph of car architecture. A composite car is one composed of compartments for various classes of passengers. This one had also a place for baggage. But the arrangement that surprises the natives is the placing of a lavatory in connection with the first-class compartment. The lavatory is merely one compartment fitted up for the purpose and accessible from one first-class compartment. The door between the two compartments occupies the place of one seat, leaving sitting room for only five persons in the compartment which the lavatory is designed to accommodate. The car is 51 feet long and is carried on two six-wheel trucks. The latter are made after the style of our own six-wheel trucks, but of an ancient pattern, with the spring board supported by hangers. A supplementary spring is placed on the top of each axle box, outside of the truck frame. No equalizers are used. The truck is simple enough in design, but consists of a multitude of details.

The portion of the exhibition representing early specimens of railway machinery is very interesting. First among this display may be mentioned an engine designed by Richard Trevithick, who is regarded here as the inventor of the high-pressure engine. This engine, which is a small upright with an exceedingly primitive tappit-valve motion, was built about 1804. It was found in a dismantled state by Mr. Webb, of Crewe, and preserved. Unless some of Oliver Evans' oldest engines have escaped the scrap heap, this is doubtless the oldest high-pressure steam engine in existence. The old engine of Stephenson's called the "Locomotive," that was exhibited at the Chicago Exhibition of Railway Appliances in 1883, is here, and attracts about as much attention as it excited in our own "Old Curiosity Shop." A strong effort was made by the promoters of this exhibition to obtain the "Rocket" from its place in the South Kensington Museum, London, but they failed. There is, however, to be seen a full-sized model of the Rocket as she appeared during the trials on the Liverpool & Manchester Railway in 1829, when she demonstrated that a locomotive could be made to run twenty-five miles an hour. The general appearance of this engine is well known, but to us many of the details were full of interest. The fire-box is separate from the shell of the boiler, and connection is made between the boiler and top of fire-box by means of two three-inch pipes. The cylinders are behind the driving-wheels, and incline towards the top of the back boiler head at an angle of 45 degrees. The steam chest is below the cylinders, and the valve gear, which is the drop hook, is operated from a rocker placed behind the boiler head. The engine is carried on a bar frame, to which the axle box pedestals are bolted. The early American locomotive, before the truck was introduced, adhered very closely to the design of the "Rocket," only their cylinders were placed ahead of the driving wheels.

The authorities in charge of the Liverpool Exhibition do not give the representatives of foreign papers any facilities for obtaining information about the exhibits. They have to take all their notes outside the railings, and few of the parties in charge of exhibits are able to give any particulars about the details. The man in charge of Sharp, Stewart & Co.'s locomotive was dreadfully shocked because we climbed over the railing and went up on the foot plate. We wanted to go inside the fire-box, but he firmly refused to permit any such freedom, and it was by the exercise of persistence which was subsequently denominated Yankee cheek, that we got the fire box door opened to get a peep in. No persuasion could induce the man to open the smoke box door. Under these circumstances we did not feel inclined to force information from them.

There are two other Exhibitions open in the British Isles where railway machinery forms a prominent feature. Of them we will write for future issues.

THE John P. Squire Live Stock Line have put the Boston Automatic Coupler on 384 of their cars, and 50 cars of the Boston & Lowell road have also been equipped with it.

AN electric railway has been formally opened at Windsor, Ont. There were invited guests, a substantial lunch, neat speeches, applause, cheers and cordial wishes that the road would be a great success.

AMERICAN manufacturers have just achieved another triumph in the award of the contract for 280,000 ft. (53 miles) of wire rope for the proposed new cable lines in Melbourne, Australia, where it has just been decided to build twenty-six miles of cable road.

THE first of five locomotives of an entirely new design has been turned out at the Philadelphia & Reading shops. The new engines are of the Wootten patent, and are intended for the Bound Brook division. Five of the same kind are being constructed at the Baldwin Locomotive Works. It is claimed that this locomotive can maintain a speed of sixty miles an hour, drawing six to eight passenger coaches.

THE DICKSON MANUFACTURING CO., Scranton, Pa., has just closed a contract for 15 passenger locomotives, 16 × 24 in. cylinders, for the St. Louis, Arkansas & Texas road, to be delivered in October. They are also busy on 10 locomotives of the same class, and some moguls, for the Del aware & Hudson Canal Co.; also two passenger engines, 17 × 24 cylinders, for an Arkansas road, and several light engines for other roads.

HERAPATH (London) speaks of a Canadian Pacific train that arrived safely at Vancouver's Island in six days, and says: "A nice trip of course in summer, but what will it be with the thermometer below zero? By the way, the train carried 140 passengers. Even supposing all paid, we should like to know the loss on the trip. It looks as if the line was built before the traffic. Under healthy conditions it should have been the reverse."

A NEW photographic car is in use on the Northern Pacific railroad. It is 66 feet long, has six-wheel trucks and is built after the Pullman pattern. It has observation, reception and operating rooms, and all necessary arrangements for doing photographic work. Its headquarters are at Fargo, where the pictures are finished and mailed to customers. Its coming is announced beforehand by bill posting the same as a traveling show, and the novelty of the thing attracts every body's attention. Aside from portraits, a large amount of landscape work is done for the Northern Pacific Co. The cost of the car was about $13,000.

THE great cantilever bridge across the Ohio River, connecting the cities of Louisville, Ky., and New Albany, Ind., is completed. On Thursday, July 15, it was tested by the builders and owners. A train of about 15 cars, heavily loaded with stone, drawn by two Mogul engines, each weighing 90 tons, coupled together in the middle, was run across the bridge and back. Forty wagons loaded with pig-iron were on the bridge at the time. The train was afterward run at ordinary rate of speed, and suddenly stopped in the center of each span. The bridge accommodates foot passengers, wagons and street cars, the railroad track being in the center, and inclosed with high walls of planking.

Railway Master Mechanics' Association.

NINETEENTH ANNUAL CONVENTION.

The nineteenth annual convention was held in Meionaon Hall, Boston, commencing June 15, and was called to order at 10:15 o'clock, A. M., by the President of the Association, Mr. J. Davis Barnett. Upon calling the roll, 77 members and associates answered to their names. Twelve new members joined the association, and several other members arrived later.

Prayer was offered by Rev. Mr. Perrin.

Mayor O'Brien, of Boston, welcomed the members and tendered them the hospitalities of the city. He spoke of the importance of the association and the high duties performed by master mechanics.

PRESIDENT BARNETT'S ADDRESS.

LADIES AND GENTLEMEN: It is a real pleasure to meet with you and greet you once again. Your happy faces tell a tale of good health, of high spirits, and of ability to respond to and enjoy, not only the civic hospitality so kindly extended to us by this good city, but to appreciate all its other good things.

I have often expressed my personal feeling that Boston is the most charming city to visit on this continent. I regret that I was not a member, and therefore had not the pleasure of attending the convention that was held here 14 years ago (1872), yet those who were—I know by their vivid recollections of that time—have most happy remembrances of the right hearty way in which our Association was welcomed, and its financial position then strengthened; and we believe that the warm words of welcome we have just heard from His Honor Mayor O'Brien are a genuine expression of Boston's feeling toward us.

I am glad to say our Treasurer's and Secretary's reports are encouraging; they show an unspent balance, and our membership has not lessened, although to our sorrow and regret, since last we met five members have gone over to the majority. May they rest in peace!

It is possible that the change of mileage from broad to standard, carried out during the last few days on the Southern States, may yet keep the members there resident so busy that we shall not see all of them this year. Should this unfortunately prove to be the case, I much regret that the dates should have fallen so close together as to make it impossible for all to attend this meeting, which I had hoped, and still shall hope, will not fall behind any previous one, either in attendance, interest or educational value.

That the ladies continue to favor us with their presence and kind smiles is a matter of happy congratulation, and they must not think my thanks are not real and the words are feigned, even if they do come from a bachelor.

This morning, more particularly to our working and junior members, I wish to speak a few words on the "Uncertain in Locomotive Engineering" and how we can best reduce it. The certain is the concrete results of past experience; it is familiar, prosaic, and it fails to keenly interest or stir us; but that which is still uncertain, still undefined, the test or experiment our friend has in hand, the problem we are trying to solve—these unconsciously draw out our enthusiasm; as we thus hope to obtain one more point of indisputable fact, to make the foundation of our daily practice more firm, to take another and a closer grip on nature; and it is this continually obtaining, this breaking down of the barriers, this wider survey and clearer plotting of what recently was an unknown territory, that gives the growing interest to our profession, and to these our annual reunions.

Critics (and not necessarily unfriendly critics) have said that individually in convention we make contradictory statemen's, and collectively our published proceedings are conspicuous by the absence of definite conclusions and formulated results.

It seems to me that there is small cause for wonder that statements appear to be contradictory, when it is considered how numerous are the differences in metal, in fuel (and can I add, in men); how great the variation in service the materials are put to, and also over how many substances one word is stretched to cover. May I illustrate? We commonly use the word "soft coal," as if it were a single definite, almost elementary substance, ignoring the fact that the varieties from the same bed and seam are numerous, and that two specimens which chemical analysis shows to have practically equal percentages of the same constituents are seen to behave very differently when distilling on the "scrade," yielding different residues, as well as showing large variation in calorific power.

"Steel" is another common instance in illustration. What a bewildering variety of substances, with highly differentiated qualities, does this little word cover, and how wide the differences necessary in its treatment, from tool steel injured by high heat, to boiler plate which is made dangerous to human life if it has been worked at low or colorless heats.

Therefore, when circumstances so greatly differ, and the use of a similar word is so far from implying that a similar substance is referred to, should it be a matter of surprise if a member's statement that so and so is *black* is directly followed by another's that it is *white*? The thought I desire to impress upon you is the necessity for noting and fully stating all the qualifications or circumstances limiting the observed fact; we shall then see these apparently diverse statements fall into parallel lines, and the conclusion (in many, if not most cases, indorsed by the majority) shows that it is *gray*, or a mixture of both black and white.

All the circumstances qualifying, influencing or seemingly only coincident with an observed experiment, should be noted. For the trend of modern scientific research is to show that it is the small circumstance (so small and apparently so trivial as to be overlooked for years) that proves to be the missing link, the missing ward in the key that unlocks the puzzle, showing the complete yet simple operation of cause and effect.

We need to educate the closely observant eye that will *not* be deceived by superficial appearance into lazily concluding that the apparently familiar result is exactly the old, well-known incident, with nothing but the old lesson to teach and the old law to enforce.

Hence the value of seeing any fact in physics, or any experiment, with our own eyes; and also, because of the liability to usual deception of seeing the same thing through the eyes and mind of one or more independent observers, of noting the points brought out, that to them seem most prominent and closely related, the sequence or order in which they follow, and their relative proportion to and influence the one on the other.

We can, I think, best get into this good habit—considering the pressing limitations due to time and business calls—by free mutual exchange of experiences, and our Association is based on that belief; but each statement we make, to be current at its full value, must be specific—*something* more than a flat contradiction, or an "I don't think so." Let us strive to give the *why*, as well as to state the naked fact that in our observation it *is* so.

We can by striving get the *why;* for it is certain that regularity and eternal law reign throughout the most diverse results. This is our unshaken foundation. If results seem to vary, it is because we either do not know, or have not observed the conditions that insure success. The defect is in ourselves, for nature's laws know "neither variableness nor shadow of turning." Open eyes, unblinking observation, energy and freedom from forgone conclusions, are necessary; not that nature is deceitful, but she does not disclose her hidden charms except to those who ardently seek them.

Foregone conclusions are a fruitful source of error. Let us for an illustration turn again to steel, used successfully to sustain rolling friction, yet a failure when inferential reasoning led to its application to resist rubbing or sliding friction. To make a fair trial of the rolling of steel tires on steel rails was to recommend the exclusive use of steel; it did its work so well, had so long a life, so little frictional resistance and possessed such high powers for resisting abrasion; yet the attempt to *slide* one polished steel face upon another, as an eccentric inside its strap, or a cross-head upon its slide-bar, has not to-day reached the stage of successful experiment.

It is now clear that any inference obtained from experiment in rolling friction between metals will not apply to sliding friction; to think you can do so is a futile attempt to get at nature's law by a foregone conclusion. The same may be said of any attempt to apply resistance rules deduced from friction at low velocities to practice at high velocities, and it was unwise to expect that boiler plate with 1-300 part of carbon would behave the same as if it contained but the 1-700 part, or even a more minute fractional part of phosphorus.

These are trite examples, but they the better serve to exphasize the necessity for clear discrimination between things that seem to differ (if at all) but very slightly, and also to remind us to properly qualify and elucidate our statements, and to closely observe the small things.

Dr. G. Gore has shown how widespread and inclusive are the influences of seemingly small causes. Thus warmth, or even moderate pressure, applied to a piece of steel definitely and in most cases measurably altered its "length, breauth, thickness, molecular arrangement, atomic distance, specific gravity, cohesive power, adhesion to liquids, elasticity, temperature, specific heat, latent heat, thermic conductivity, thermo-electric power, electric conduction, resistance, magnetic capacity, chemical and chemico-electric actions, and a number of other properties simultaneously;" so that his vivid experiments almost produce the impression that this metal is endowed with vitality.

Thus, although we need not pay attention to all these points, you see that if we treat metal as inert, and stable under all except extreme variations of temperature and pressure, we shall be deceived, and find our attempted application of experimental results to daily practice very disappointing; but if we carefully discriminate and notice the small signs we shall make fewer mistakes, have less failures in daily work, do something to lessen the still wide field of the uncertain, and increase the present narrow swath of the known and certain.

May I now thank you for the kind and considerate attention with which you have listened to this dry prosing. Remember, in extenuation, that it is the nineteenth year you have listened to an address from the chair, and the possibilities of something new and interesting to all seem—at least to me—very limited.

SECRETARY'S REPORT.

The report says in respect to the membership:

Since the last report of the Secretary, 22 full members and 2 associate members have united with the association. Three names have been dropped from the rolls for non-payment of dues, and it is with due solemnity and regret that duty compels me to announce that five well-known names will be sadly missed at our future gatherings: George Boyden, W. M. Pendleton, G. H. Dotterer, I. C. McCuen, and John Ivanson are dead. With these changes, the association numbers 10 honorary members, 14 associate, and 245 full members, making a total of 264 as against 236 for last year.

The Barton Fund, the nucleus of which was presented to the association by its friends in this city, consisting now of a principal of $5,294, invested in government bonds, and an uninvested interest from last year of $98.93, the July interest of 1885 of $52, October interest of $52 or January interest of $52, and an April interest of 1886 of $52, making a total of uninvested interest of $306.93, is still retained in the vaults of the Safe Deposit Company of Cincinnati, for which is paid an annual rental of ten dollars per year. This interest will doubtless be ordered invested as provided by our By-laws at the first meeting of the Trustees.

Mr. W. E. Lockwood raised objections to the accuracy of the Secretary's minutes of last meeting as published, and moved that certain corrections be published as a supplementary report.

This led to a long discussion, which was finally closed by the meeting passing a resolution sustaining the minutes as being substantially correct.

SELF-DUMPING ASH-PANS.

The hour devoted to the discussion of short questions having arrived

Mr. G. W. Stevens asked "What Good are Self-Dumping Ash-Pans?" He explained that the question was suggested by the assertion published in a pamphlet on the authority of a master mechanic, that by the use of slack coal and one of those pans, a saving of $6,489 47 had been effected. Another was claimed to have saved 15 pounds of coal to the mile by use of the device. He thought if members had pans of that kind saving the coal claimed, it would be well to give more particulars of how it was done. If it was not done, the practice of giving testimonials loosely should be stopped.

Mr. M. L. Collier said he had used a pan of this kind and found it a convenience in dropping out the ashes, but he could not see how it was likely to save any coal.

Mr. Jacob Johann never was able to see the point where a self-dumping ash pan should lead to economy of fuel. It was convenient for cleaning, and that was its sole advantage, while it had many obvious disadvantages. On his way to this convention he had seen an extraordinary number of burned ties on one road, and thought they were probably using self-dumping ash-pans.

Mr. Collier said the claim made by the parties selling the ash-pan was that it prevented setting fire to ties.

Mr. H. A. Whitney said they had several of those ash-pans, but he had no idea that they saved any coal. They, however, saved the labor of handling ashes, and during the heavy snows they have in winter, these pans are useful because they do not fill up with snow and ice. Their engines make a run of 180 miles without having the fire cleaned, and this ash-pan was an advantage where that was done.

Mr. J. S. McCrum failed to see where a self-dumping ash-pan could lead to saving of coal. He had tried them some years ago, and came to the conclusion that it was not safe or desirable.

Mr. R. H. Briggs thought they were getting down very low now. We had wrestled with smoke stacks and extension smoke boxes, and now we have got down to the ash-pan. It was time to dump the ash-pan. He prevented the ash-pan from freezing up in a hard winter by running without one.

Mr. Stevens moved, "That this association deprecates the practice of giving letters or testimonials to any one for publication." He said they ought to restrict themselves to answering letters of inquiry. This was the practice followed by the Pennsylvania Railroad.

President Barnett thought we did not need to pass a resolution to be moral men.

Mr. Johann wanted each member to appoint himself a committee of one, intrusted with the duty of refusing letters of recommendation.

The resolution was then carried.

THROTTLING THE LOCOMOTIVE.

Mr. Augus Sinclair asked the question, "Is the present form of quadrant satisfactory as a means of regulating the cut-off?" He said that in indicating locomotives he found that great loss of steam resulted from the notches of the quadrant failing to supply the means of regulating the cut-off closely. When an engine working in the 6-inch notch would not handle a train the lever had often to be dropped to the 9 inch notch and the steam throttled. He found it took from 15 to 20 per cent. more steam to do the work in this way. A locomotive could be made to approximate the economy of an automatic cut-off engine when the steam was admitted unthrottled. Those who were familiar with the steam reverse gear knew the advantage it gave in regulating the cut-off. A screw reverse instead of a lever and quadrant had given good results, and he thought this was a desirable line of improvement.

FORM OF EXHAUST NOZZLES.

Secretary Setchel asked the question, "What is the value of substituting a rectangular exhaust tip instead of a round one, as had been done on the Pennsylvania Railroad?" He believed the purpose of the nozzle was to emit the steam so that it would expel the air from stack and smoke-box, and to do that properly he thought the section of nozzle and stack should coincide.

Mr. Briggs aimed to get as perfect a vacuum as possible in smoke box, and used a round nozzle for the purpose, as he looked upon the exhaust tip as a sort of pump. The steam passing up through the stack acts like a piston pumping the air out of the smoke-box. He could not see how a rectangular form of nozzle could be any advantage.

Mr. Johann thought the form of exhaust nozzle was to a great extent a matter of expediency. He agreed with Mr. Briggs that its purpose was to expel the air as perfectly as possible from stack and smoke box. He did not see that the shape of nozzle would make much difference, but he preferred a round nozzle because it could be finished easier than one with square corners. What was most wanted with exhaust pipes was room enough to get the steam out of the cylinders as rapidly as possible, while creating enough vacuum to keep the fire burning actively enough to maintain steam.

Mr. E. A. Campbell asked what difference the shape of nozzle could make when the steam passed through a petticoat pipe?

Mr. M. N. Forney wished to know what difference there would be in the shape of the exhaust steam when it came through a round nozzle, from what it would be when it came through a square one. The discussion reminded him of a dispute he once heard of about how certain oils would not lubricate. A man said his oils lubricated because the particles were globular, but his neighbor's oils were diamond shaped, and that kept them from lubricating. He did not know that any one had found out the form a current of steam took after it passed into the chimney, and a discussion on the subject was not likely to do any good.

Mr. Sinclair thought the draft in the smoke stack was maintained on the same principle that a current is maintained in an injector. If Mr. Forney will try an injector with tubes of rectangular section, he will find a decided difference in the amount of steam needed to raise the water. There have been a great many experiments made at one time and another to find out what form and position of nozzle would produce the best vacuum and would make steam the easiest, and it has been decidedly shown that a round nozzle about the diameter of the stack below the stack opening was best. This is not a mere assumption, but the result of carefully conducted experiments. Mr. Martin, in a report to this association some years ago, gave interesting and edifying data about exhaust nozzles.

Mr. E. M. Roberts: Apart from the advantage one form has over another, round nozzles are easier cleaned out than square ones. He would retain the round nozzle on this account alone.

Mr. W. H Selby had tried all forms of nozzles, and got the best service out of the round nozzle.

Mr. N. W. Howson had used square and round nozzles, but found no difference in their action. He now uses the round nozzle, and sees no reason why he should change.

Mr. Forney was raised where square nozzles were used, but saw no reason why they should be superior to round ones. A gentleman near him had said square nozzles could be put closer together than round ones. He called on Mr. Sinclair to produce any data he had in favor of round nozzles.

Mr. Ames had been connected with the Pennsylvania, and used both forms of nozzles. Did not know any difference in their action.

Mr. Setchel had heard, in a joking way, that in the days when engineers got any changes they wanted made on their engines, rectangular nozzles were introduced on the Pennsylvania, because engineers could measure that shape as easily as round ones.

Mr. Briggs spoke of the valuable experiments made by Mr. Martin where he found that a single nozzle was superior to double. He himself acted on the suggestions of these experiments and found the single nozzle best.

Mr. Sinclair gave some particulars of Mr. Martin's experiments, and praised the report thereon as being one of the most valuable papers ever published by the association.

Mr. Wm. Woodcock remembered presenting the report referred to. The conclusion arrived at was that the compound nozzle was best. This was double nozzles carried within six inches of the top and ending in a single opening.

Mr. Charles Blackwell had heard a great many faults found with the single nozzle. He thought most of the complaints were well founded, the shape of the nozzle being to blame. Had made many experiments with single and double nozzles, and at first found single nozzles gave disastrous results in the shape of excessive back pressure. Found this could be removed by improving shape of exhaust pipe. Found it best to bring each of the exhaust pipe openings where they join down to about the same sectional area as the nozzle has. By doing this he reduced back pressure from 23 pounds down to practically nothing.

Mr. Campbell asked the size of the single and double nozzles employed.

Mr. Blackwell: The experiments I made were with consolidation engines, and to the best of my recollection the single nozzle was 4¼ or 4¾ inches diameter, and each of the two pipes at the junction with the single pipe were 4¾ inches diameter. The lower casting was made so that it could be bored out if a larger opening were desired.

Mr. Briggs: What size were the cylinders?

Mr. Blackwell: 20 × 24 inches. The best results were obtained by lowering the nozzle 36 inches below base of stack, and encircling it with a basket netting. I could then use 4¾ inches nozzle and get all the steam I wanted. In this shape the engines steamed better than with 3¾ inch double nozzles or with a plain single nozzle 18 inches below the base of stack.

CHECK VALVES.

Mr. Campbell wished to hear some discussion about a check valve he had recently examined, and which was placed inside the boiler. He had never seen anything of the kind before, and wished members familiar with the arrangement to give particulars. He understood it was adopted by the Pennsylvania.

Mr. Ames stated that a check valve inside the boiler had recently been applied to some Pennsylvania engines. In talking with several master mechanics about it the reports were not altogether favorable, but it had not been in use long enough to determine its true value.

Mr. Forney stated that at the convention held at Providence some years ago, he had the honor of submitting a paper on check valves and other perforations in boilers. He had taken great interest in the subject. The check referred to here was doubtless one Mr. Hayward, of Jersey City, had something to do with. It is placed inside the boiler and arranged in such a way that in case of accident or the knocking off of what projects outside the boiler, the hot water and steam inside will not escape. The members may recollect a bad accident which occurred near Pittsburgh, where several persons were scalded to death by the escaping hot of water and steam from the boiler into the car. This was a case where a locomotive ran into the rear end of a passenger train and had the check valve knocked off. Believed it was the results of this accident that induced the Pennsylvania authorities to try the inside check. He was induced to speak on this subject in the interests of humanity; thought the members of this association had no idea of the perfectly horrible accidents which occur by scalding after collisions. Some years ago he had collected all the information he could find relating to accidents of this nature, and the details of some of them were so perfectly horrible that it seemed the Association ought to give the matter special attention. The evil grows out of the fact that in the construction of locomotive boilers you fill them full of holes, and then screw some projection into them, so that they resemble a porcupine. In case of collision, some of the projections get knocked off, and the hot water escapes, scalding people within reach. Whatever can be done to remedy the danger ought to be done. The master mechanics are the proper men to apply the necessary safeguards.

Mr. Blackwell stated that Mr. Webb, of the London & Northwestern Railway, introduced the feed-water at the boiler head and carried it forward in pipes. He thought this, to a great extent, prevented the danger pointed out by Mr. Forney. It was a plan easily applied.

SECOND DAY'S PROCEEDINGS.

Mr. Lauder moved that as Mr. W. E. Lockwood had been permitted to join the association, when, according to the Constitution, he is not eligible to membership, the Secretary be instructed, to erase his name from the roll. (Carried.)

REPORT ON LOCOMOTIVE BOILER CONSTRUCTION.

To the American Railway Master Mechanics' Association:

Your committee on improvement of Locomotive Boiler Construction respectfully submit the following as the result of their labors:

With a circular of inquiry sufficiently broad to embrace the most minute improvement, and giving admittance to any and all boilers, your committee regret that very few replies have been received. Mr. J. Davis Barnett furnishes an admirable six-page paper on Anthracite and Bituminous Coal Burning, from an economical point of view. Mr. J. Snowden Bell furnishes an exceptionally interesting paper of 30 pages on improvement in locomotive boiler construction, with special reference to enlargement of grate area to reach a minimum consumption of fuel, and the utilization of waste or refuse fuel. Both papers are particularly interesting, will repay careful perusal, and your committee request that they be read before the convention and embodied in their report.

Mr. G. W. Stevens writes your committee that his company have had built by the Schenectady Locomotive Works three 18×24 in. cylinder, 5 ft. 6 in. driving wheel passenger engines, with boiler carrying 180 pounds working pressure. As the engines have only been in service a short time nothing definite can be said of the benefit of the high steam pressure. No trouble whatever is experienced with the valve and cylinder surfaces, and evidence is given of a fuel record that will not exceed five pounds of coel per car mile, with trains of 10 cars, equal to 280 tons, exclusive of load, running on a schedule time of 37 miles per hour.

Mr. William Woodcock writes that nothing new has occurred in his practice during the past year, but gives sound advice in advocating steel as the best material for boilers, and with the present tendency to larger boilers, better workmanship and abhorrence for that instrument of boiler torture known as the drift-p:n.

Mr. Thomas Twombly reports progress in larger boilers and heavier material.

Mr. Johann—Nothing new.

Mr. Allen Cooke expresses a preference for the wagon-top boiler, of sufficient size to warrant plenty of steam.

From the work of N. P. Burgh (on boilers) your committee reproduce a return tube boiler, which is not identical but substantially the same as the Coventry boiler, as reported in eighteenth annual proceedings of this convention; this is not presented as anything new, but to verify the remark by a member at the last annual convention, that some devices were presented as new, when, in fact, they were 30 years old. In connection with this it is interesting to note the different forms of boilers that have appeared from time to time, particularly those of a comparatively early date; they all bear close resemblance, the designers ignoring the principle of direct application of heat and imagining that heating surface could be sacrificed and the best results obtained by the introduction of any distortion—evidently believing that the efficiency of the boiler was increased just in proportion to the circuitous route of the heat from the fire-box to the tube.

Mr. J. E. Jerrold, of the Chicago, Milwaukee & St. Paul Railway, furnishes your committee with drawings of his curved boiler seam, as applied to longitudinal seams for the purpose of securing maximum strength, and avoidance of concentrated strains, and kindly furnishes a letter giving the results of pressure test, as applied to steel drums, constructed for the purpose, showing the point of rupture. The letter giving method of testing, pressure applied, etc., is submitted herewith.

Your committee conclude that with the return of activity in locomotive building, improvements will become more manifest, and that this association, as in the past, will continue in the collection and dissemination of knowledge which has made the locomotive boiler a triumph of mechanical skill and placed the locomotive in acknowledgment as one of the most economical of high-speed engines.

G. W. STEVENS,
WM. FULLER,
T. J. HATSWELL,
Committee.

After some routine business was disposed of the report on boilers was taken up for discussion.

Mr. Lauder urged the members to give their views on matters relating to boilers. He spoke about the prevailing trouble experienced with mud rings leaking, and attributed it to faults of construction. There was so much tension on the mud-ring fastenings that he became persuaded the usual single row of rivets was not sufficient, and he had adopted the practice of putting in two rows of rivets with the very best results. When that was found necessary, with the pure water used in New England, he though it essential where the feed-water was full of lime. A strong seam would prevent leakage, and it was their duty to prevent the mud ring leaking.

Mr. Campbell acknowledged that he had experienced trouble with mud ring leakage. He wished to know how Mr. Lauder got rivets through the corners.

Mr. Lauder explained that these rivets were tapped in. They were plugs rather than rivets. There was no more difficulty in securing the corners when a double row of rivets was used than when it was single. The plugs were screwed into the ring and then headed over in the usual way.

Mr. Setchel said the Lake Shore road had recently put into service locomotives with boilers intended to carry 180 pounds of steam. He called on Mr. Stevens to give some particulars about these boilers.

Mr. Stevens replied that the engines were used for fast passenger service, and, as the saying was, "they got there," but they had not been in service long enough for him to give particulars. Sees no reason why higher steam pressures should not be adopted.

REPORT ON DRIVING WHEEL CENTERS AND SECTION OF TIRES.

To the Railway Master Mechanics' Association:

Your committee appointed at the eighteenth annual convention, to consider the subject of "Standard Diameters of Driving Wheel Centers and Standard Section of Tires," beg leave to submit the following report:

In considering the question of standard diameters for driving wheel centers, we have thought best to recommend such diameters as would enable the largest number of locomotives now in use to be brought to the proposed standards with the least trouble and expense.

To enable us to arrive at proper conclusions, we caused circulars to be sent to each member of the association, requesting information as to the diameters of wheel centers now in use on their respective roads.

We have received replies from 38 of the leading roads, owning an aggregate of nearly 8,000 locomotives.

While we find a great variety of sizes of wheel centers, the variation is not so wide as to preclude the possibility of bringing a large percentage of them to a standard.

Your committee feels that this question is one of great importance, as well to the manufacturers of tires as to the railroads, as, in the case of the manufacturers, the adoption of standard diameters of wheel centers by the railroads will enable them to carry a stock of standard tires, which can be made up at their convenience; and in the case of the railroads, the necessity for carrying a stock of tires will be obviated, because manufacturers will be able to fill orders at short notice.

If desirable, manufacturers can furnish tires bored to gauges, ready to be applied to the wheel centers. This will be a substantial benefit to both parties.

In considering this matter, your committee believes it most practicable to establish the diameters of the wheel centers, making them even inches, and allowing fractional parts of the inch to apply to the diameter of the tires.

We would recommend for standard diameters of driving wheel centers for the various sizes of wheels in use under locomotives of standard gauge, 38, 44, 50, 62 and 66 inches.

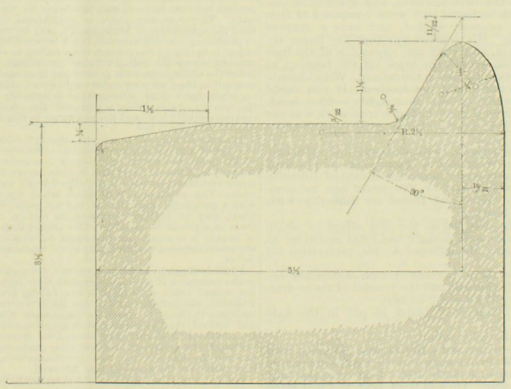
Your committee considers it unadvisable to take action in this matter with reference to narrow-gauge locomotives, as there are comparatively few roads of gauge other than standard and those now in existence are rapidly changing, so that in a few years the railroads of this continent will be with very few exceptions of uniform gauge.

We would further recommend that arrangements be made with the Pratt & Whitney Co., or some other reputable manufacturer, to furnish gauges for both wheel centers and tires, to railroads, locomotive builders and tire manufacturers, at a reasonable price to be fixed or agreed to by a representative of this association, to the end that all parties in interest may have absolutely uniform gauge measurements. Without such uniformity it will be impossible for manufacturers to furnish tires bored to fit, with certainty that proper shrinkage is allowed.

We believe the requisite allowance for shrinkage to be one one-hundredth part of an inch for each foot of diameter of wheel center.

We have also prepared a drawing of section of tire, which we submit to the convention for consideration.

J. N. LAUDER,
J. JOHANN,
H. W. SPRAGUE,
Committee.



Section of Tire.

Mr. Forney mentioned that the Master Car-Builders' Association had the adoption of a standard tread of tire under consideration, and he thought it desirable that the tread of driving tire be made of the same form. A locomotive wheel of one shape passing over a rail, followed by car-wheels of another shape, would produce greater wear on the rail than if they all conformed to one pattern. He preferred a greater radius of throat of flange than that recommended by the committee.

Mr. Lauder thought the desire among the master car-builders was to made the radius of throat less than ⅛ inch, but it could not easily be done on account of the chill. This objection did not exist with locomotive tires, and they proposed what was considered the best form. But he was not in favor of establishing a standard form of tire section at present. It was different with the case of wheel centers. Thought a decision about them should be come to without delay. The establishment of standard centers would be a decided advantage to railroads and a great convenience to tire makers. If standards were established, tie makers would keep stock on hand all the time ready, bored out. The gauges recommended by the committee were important. It is a recognized fact that no two shops can make a piece of steel 5 feet long of exactly the same size. The best thing they could do was to get Pratt & Whitney, Brown & Sharp, or some other company noted for doing accurate work, to get out the gauges, then they would be sure to have the sizes uniform. He hoped the sizes recommended would be adopted.

Mr. Johann believed it important to arrive at an agreement about the sizes of wheel centers. The question of tread might stand over without loss. He had considerable experience bringing driving wheel centers to uniform sizes on different roads, and recognized the importance of the work. He had completed his work in this line on two roads, and was now engaged in his third term of reformation. First, he took iron tires on hand. They had to carry a heavy stock because no two wheel centers appeared alike. Out of 65 engines on one road when he took charge, he reduced the sizes from 40 to 6. This saved much expense for labor, besides reducing the necessary stock. When he joined the Wabash, steel tires had come into use, and there he found all dimensions of centers. When he left, all the engines except a few worn-out ones were brought to standards covered by four sizes.

Mr. Forney moved that action on the form of tread and flange be postponed. Carried.

Mr. Chapman: Some years ago a committee reported on this subject, and their recommendations were ignored. Hoped this report would meet with better treatment. Regarded the subject as very important, and urged the necessity of adopting standard forms for center and tread. Manufacturers could not make tires according to blue prints often furnished.

Mr. Sprague asked if tire makers were rolling tires with bevel? He thought gauges were needed to check work turned out by manufacturers.

Mr. Chapman answered that tires were rolled with beveled tread. He believed it quite proper for railroads to have accurate gauges.

Mr. Johann had the tires he ordered bored out to gauge. Never yet lost a tire that was ordered in this way. It is very convenient, too. He would take an engine in off the road and in four hours have an entire set of new tires on.

Mr. Chapman said the practice of ordering tires bored out was on the increase. He had received an order lately for tires for an engine where no two of the centers were of the same size.

Mr. Howson thought this one of the most important subjects the association could take up. But if a standard were adopted and the members did not pay any attention to the recommendations of the association, the work had better be left undone. He strongly urged members to adhere to standards.

Mr. Lauder asked what advance was made in the price of tires ordered bored out.

Mr. Chapman answered 4 cent a pound.

Mr. Mackenzie moved that the portion of the report recommending standard centers be adopted.

Mr. Sprague moved to add 60 inches to the list.

Mr. Chapman knew of cases where master mechanics used worn-out tires to bring up wheel centres to their standard size.

Mr. Cooper said he had eight engines with which he adopted this plan to increase the centers. He left on the old tire and turned off the flange. Had no trouble, although they used 4-inch tires.

Mr. Lauder spoke against increasing the number of standard centers.

Mr. Johann hoped each member would not insist on having his pet sizes. Out of 56 engines he had not ten with uniform sizes, but he would contrive to conform to the standards recommended.

Mr. Mackenzie's motion was then carried.

Mr. Sinclair mentioned that the standards recommended by committee did not apply to elevated railroad loccmotives, and they were a growing class.

Mr. Gordon moved that the committee be instructed to arrange with some firm about the making of standard gauges. Carried.

Mr. Johann said elevated railroad companies knew what sizes suited them best and they could establish the sizes, being a law unto themselves.

Mr. Lauder said if elevated railroads want standards, the committee would consider any suggestions in that direction.

STEEL FOR DRIVING-AXLES.

The time having arrived for the discussion of short questions,

Mr. Woodcock asked, "Is it desirable to continue the use of steel for driving axles?" This question was suggested by one of the members saying that he had used steel axles for some time, but had gone back to the use of iron, because he found that the steel broke or gave poorer results than iron. His own experience had been different.

Mr. Lauder's observations and experience since homogeneous steel came into use for axles, pistons, crank-pins and the like, had given him very decided views, which were to the effect that steel is not suitable for these purposes. So firmly did he hold this view that he had removed steel in these parts from engines not three years old, and substituted iron. Although every thing was apparently all right, he did not dare run the engines longer on fast passenger trains for fear of breakage. Perhaps others might have had different experience, but he had had poor results from steel. Had not used Krupp steel for the purposes named. Some roads are using this steel for these purposes. In some instances where steel had done badly with him, it might has been owing to inferior or faulty design. It is well known that sharp corners in steel invite disaster, and he had known instances where axles were put on with the wheel-fit somewhat smaller than the journal, and turned up to square corners. That, he thought, they must expect would break sooner or later with any material, but he believed iron, under those circumstances, would be safer than steel. They had broken quite a number of steel axles, and in some instances they were cracked entirely round, leaving only a spot on the center to hold them. He had also seen the same thing with iron. In those instances the wheel-fit was turned smaller than the journal, leaving a square corner. With good homogeneous steel, and sharp corners avoided, he presumed, steel would give satisfaction, but his experience had been in the opposite direction. As far as the wearing of the material went, he preferred iron, as it glosses over, and makes a smoother wearing surface than steel. Possibly, steel being the denser metal, the lubrication may be more imperfect, for the small cells in the fibrous iron may fill with oil and assist lubrication. That may account for the difficulty of running steel cool. Had steel crank-pins rather small for the service that would run warm all the time. Put in hammered iron and found no trouble from heating. This had happened several times. Steel will break in curious ways. He regarded it as an uncertain material when subjected to varying strains, as in piston rods. Had piston-rods break within a year in the cross-head, half way between the key-way and the shoulder. Now, it ought to have broken at the shoulder or at the key-way, yet it took the erratic course of breaking just between two weak points, and in as clear metal as he had ever seen.

Mr. Woodcock's object in bringing up the subject of steel was in reference to driving axles. His experience had been quite the reverse of Mr. Lauder's. They had some trouble with hot driving-boxes, and upon examination of the journals he found they were composed of iron that had not been properly welded, and were a mass of longitudinal seams. His opinion was that the boxes became a little warm, and that the expansion of the iron projected edges that scraped the brass of the bearing, as they found quantities of brass in the cellars. With a homogeneous steel axle this could not happen. If you could get a first-class quality of iron thoroughly welded solid, the results might be different, but such iron work was not easily got. Steel was nearly always good homogeneous metal.

Mr. McCrum's experience with steel and iron axles had been similar to Mr. Woodcock's. Some years ago he used iron axles exclusively, and found a great deal of difficulty in getting them solid. Four or five years ago he commenced using steel axles and found no difficulty with them breaking or heating.

Mr. Lauder again adverted to the bad effect of sharp corners on steel axles, and thought bad form might be to blame for breakages. He adhered to his preference for iron, however.

Mr. McCrum said there was only $\frac{1}{4}$ inch difference between diameter of wheel-fit and the journal of their driving axles, and they avoid sharp corners.

Mr. Lauder: Wouldn't it be better to put in the axle straight?

Mr. McCrum believed it would.

Mr. Sinclair was struck with the diverse opinions held on this subject. Go to one shop and the master mechanic would have nothing to do with steel. Iron was the best material in every way. He had tried both and was satisfied steel was no good. Go to another master mechanic, perhaps in the same city with engines running under conditions very similar to the other man's, and you would find he was just as much in favor of steel as the other was in favor of iron. In trying to investigate the matter, he came to the same conclusion as Mr. Lauder, that the obstacle to the use of steel was bad forms. Believed if the form was properly designed, steel was more reliable than iron but with a bad form it was not so reliable. The elevated railroads of New York were noted for the accurate records of engine mileage, and their experience with steel and iron was worthy of careful attention. It is necessary on those roads to keep down weight as much as possible, consequently every part of the locomotives was as light as it could be made safely. They tried iron axles first, and the breakages induced them to try steel. The conclusions arrived at after thorough tests of both materials were that sometimes an iron axle would wear much longer than steel, but on the other hand it might break with one-fifth the service steel might be relied on to give. They came to know the life of a steel axle, but they never could arrive at an estimate of how many miles iron would run. He had found that iron axles gave trouble by laminating when they became old.

Mr. Chas. A. Ball said Mr. Sinclair is right. The New York elevated people have got this axle matter down to a science. They run a steel axle so long and then take it out. But in the case of iron they never knew how long it would last.

FITTING TRUCK BRASSES.

Mr. Setchel wished to hear the views of members on the proper manner of fitting truck brasses into the box casting. Had recently fitted up some engines, very closely planing the brasses and boxes and making every thing accurate so the truck would tram just as well as the drivers. Objections had been raised against this practice as being unnecessarily accurate. Had recently occasion to examine engines on a road where they follow the practice of putting in the wheels without facing the hub and without planing the boxes.

Mr. Mackenzie asked how much lateral motion was allowed.

Mr. Setchel could say it was not less than $\frac{1}{4}$ inch.

Mr. Mackenzie perceived many objections to practice of that kind. A truck fitted in that way would vibrate laterally on the track. His experience had shown that the better a truck is fitted up the better are the results obtained. Thought it just as necessary to fit trucks accurately as it is to fit up driving boxes.

REPORT OF COMMITTEE ON DRIVING-WHEEL BRAKES.

To the American Railway Master Mechanics' Association:

A thorough and satisfactory discussion of the value and suitability of any of the mechanical appliances for securing brake power is possible only after a clear conception is obtained of the nature of frictional resistances as shown by experiment; and the most important point to be borne in mind is the difference in the character of sliding and rolling friction.

Sliding friction (that of all shafting and axles in their journal-boxes and cross-heads on slide-bars) is a varying but always large and measurable quantity, comparatively low in amount as velocity diminishes.

In the rolling of a cylinder on a plane, even if the surfaces are not as perfect as those usually provided for sliding, the frictional resistance resulting is very small, and the relative motion is *not* that of one surface rubbing past another, so that it is quite proper to say that at the actual point of contact between circle and line these extremely limited surfaces are for the moment at rest with reference to each other, or to say they are moving at equal and similar speed.

Hence, the positive resistance to motion due to the contact of wheel with rail may for our purpose at least be considered *nil*, as long as ordinary conditions prevail. But the primary object the application of brake resistance is to disturb these ordinary conditions, so that the touch of wheel on rail, instead of being a rolling and therefore almost frictionless contact, shall become that of sliding or rubbing at very low velocity, thus securing the highest coefficient of frictional resistance possible between two given metallic surfaces moving on each other, and achieving the final result of bringing the train to rest in the shortest time and distance.

For with engine and train in motion, all that we can do to bring it to rest is to create additional friction, and that of the brake-block on the tire is only a means to an intermediate, most necessary, but (as our patent office shows) not self-evident end, viz.: the creation of friction between rail and wheel, the two surfaces that are in rolling (or equal speed) contact, but that must be put into slow sliding contact; for, although the sliding friction of block on tire will soon destroy the centrifugal motion of wheel and axle, centrifugal force forms but a small fraction of the momentum tending to keep the mass in rapid horizontal movement.

We need not go to the mathematical labor of getting the square of the centre of gyration of a hollow spoke cast wheel (which would be necessary for any close comparison), but it can safely be said, that in the worst case the centrifugal power in the wheels (tending by their rotative contact with rail to keep the train in motion), is at any speed but from 5 to 7 per cent. of the total momentum or power requiring to be neutralized by the opposing brake; the remainder of the brake force if properly employed is used in producing sliding at low velocity or destroying rolling contact between tire and rail, this being its main and legitimate duty. Therefore any force or mechanical combination, other than the application of brake-blocks, may be used if it will result in producing this difference in *touch* between tire and rail; as our object is to change the contact from rolling to sliding, yet at the same time keep the sliding velocity exceedingly low, because the lower the sliding speed the greater the frictional resistance. It is now self-evident why we endeavor to avoid skidding the wheels; as, when that is done, although tire is certainly sliding upon rail, the velocity of this sliding is high and the coefficient of friction correspondingly low, and the resistance to neutralize the momentum of the train is low.

Thus the locking of the wheels, although it looks so effective in the eyes of a green employé, and has often been the object aimed at by quite as verdant a patentee, is a gross mistake; in effect not only injuring rail and tire, but absolutely lessening the frictional resistance between them, which is all we have to depend upon. The maximum is attained when the wheel is revolving with a peripheral speed *almost*, but not quite, equal to that of the train, and no further resistance to motion with the modern train equipment is possible. Our object then in the application of brakes is to attain just this slight difference in the nature of the touch between tire and rail; more we cannot get, and less is a defect.

Possibly it might assist in opening a discussion on the theory of brake resistance if the members gave their opinion on the following actual case: A train on a long falling grade became uncontrollable; the ordinary brakes and the driver-brake not proving sufficient to check the speed, the engineman reversed the engine and opened regulator-valve without releasing the driver-brake. Do you think he should have released the driver-brake before reversing? Two elaborate reports were made on this case, one approving the man's action, the other disapproving and holding him responsible for the accident that followed.

Before giving the substance of the replies to our circular of inquiry, it would perhaps be advisable to give a few historical notes on the application of driver-brakes. In 1855 the Baldwin Co. affixed them on an eight-wheel coupled engine for the Mine Hill Railroad of Pennsylvania. There were blocks on the two back pair of drivers, actuated by a shaft across the engine, the shaft being operated by a chain and windlass. The earliest English application known to your committee was in or previous to 1848, by Sharp, of Manchester, who on a tank engine applied wood blocks between the single driving and small trailing wheel, having wedge links (or toggle-joint) actuated by vertical screw and horizontal hand wheel on foot-plate; this arrangement, although it applied but one block on each of two wheels of unequal diameter on one side of engine only, is to-day a model of neat design and proportion. D. Goodie in 1850 used a sled-brake, about 5 ft. long, to ride on rail between driving-wheels, actuated by hand screw and toggle-joint, but it proved neither safe nor effective. One reason why neither this nor W. B. Adams' skid brake-shoe sliding down to rail on a diagonal frame bar) proved effective we now know to be from the same cause that skidded wheels are not effective in giving the fullest resistance to motion, viz.: The velocity of the surfaces in contact is too high, and therefore the coefficient of frictional resistance is low.

As early or even before 1837, John Melling, of the Liverpool & Manchester Railway, George Stephenson's first master mechanic, designed and experimented with a contrivance for utilizing, in emergency, the adhesive power of a second pair of driving-wheels, without the use of side-rods, *i. e.*, steam pistons, working in small brass cylinders, on each side of the boiler, were coupled to a transverse axle carrying on each end a free running wheel or idler. These small idler wheels, when required, were forced into frictional contact with and between the tires of main driving and trailing wheels. This device, although not a successful expedient for allowing an engine to be worked either with the freedom of a single driver or with the extra adhesion due to coupled drivers was fairly but unexpectedly a success as a driver brake; however, the low speed and limited traffic of 50 years ago rendered a driver brake practically superfluous, and the material soon found its way to the scrap heap.

In answer to the committee's query, "Should brakes be applied to the wheels of all engines?" 19 said yes, on all drivers; 3 would like to restrict them to freight or switches; and 2 are more or less opposed to their application, a few saying they have no experience or know of no satisfactory brake. Of these replies (to the disgrace of our lazy members, be it said), 8 were from engineers not members of this association, but representing an experience with many thousand engines; and if the replies in general be not treated numerically, but considered as the casting of votes equivalent to engines represented, they show an overwhelming majority in favor of the application of brakes on all engines. Mr. Lockwood sent us the official Board of Trade returns for 1884, showing in Great Britain a total of 4,177 locomotives so equipped (a personal recount makes the total 4,183), divided as follows: Various forms of vacuum, 2,990; Westinghouse plenum, 1,049; steam, 59; and all other types, 85; also it should be stated that in some cases engines are provided with two or more sources of brake-power as vacuum, steam and hand power. It would be of interest, were official American statistics available for comparison. Mr. Stevens, on the Lake Shore, 90 Westinghouse and 364 steam. Mr. Swanston recommends each railway to use one system, as it entails less confusion, less risk, less experience and less duplicate material for repairs. The motives and reasons for recommending the application of a driver-brake, which certainly does not lengthen the life of an engine considered simply as a power producing machine, are various. Some think that as the whole weight gives momentum, as large a portion of the total weight should be braked as possible. Some say their great value and only service should be for use in emergency stops, whereas others would use them on passenger engines, because they should stop quick, on switches because they stop very often, and on freights because freight trains are deficient in brake power at best of times. Another consideration is the lighter duty falling on to car drawbars, which are often said to be strained when all the brakes are in rear.

Granting, then, by reason of modern high speeds and density of business, the traffic necessity for driver brakes, what are the points that discourage their application? Do they increase the cost of working by lessening tire mileage? 4 replies received 11 say yes, or think so: 2 say they do not know, or think not, and 8 say definitely they do not, a few of the latter going so far as to say that if the proper form of shoe is used, so as to bear upon that portion of tire tread and flange not worn by rail, an *increased* mileage can be obtained.

Do driver brakes lessen engine mileage between repairs? 4 reply yes, or think so; 11 no, not much, or think not; 1 reports a tendency to fracture axle-boxes, etc.; 4 say yes, if wedge type but not if compression type is used, or pressure is equalized, and 5 ignore the query.

On the general question as to the coupling up of the brake-gear throughout the whole train, its automatic action on drivers, or whether it is advisable to allow a conductor to apply brakes on drivers, opinions vary much, but there is a general feeling in favor of enginemen having the opportunity to apply the whole brake power, restricting the application by conductors to cars or a car and tender only; that is, no one in rear should have the opportunity of applying brakes on drivers while the engine is under steam. There are three contra votes, one (the Pennsylvania Railroad) being actually equipped so that automatic action applies driver brakes.

Opinions on this point were asked in view of a free ventilation by discussion before any legislature should take hasty action upon it, or any court take the ground that if the engine brake be not coupled up and workable from rear, the possible maximum of safe brake resistance to motion is not in the hands of the train staff, and therefore hold the railway company in damages for criminal neglect; and in this light it is curious and interesting to note that a large, if not the largest railway "trade union" has, since the issue of our circular, published a memorandum of 23 requisites that, in their opinion, are necessary for the safe working of railways. No. 9 reads: "All passenger trains ought to be provided with an efficient automatic continuous brake, having the full brake power upon the wheels of the engine, tender and every vehicle throughout the train."

If so strong a statement comes from a large class of railroad employés, we need not be surprised should the matter be legislated upon without much consideration and much expert evidence from our ranks. Therefore the present moment is opportune for its discussion.

Among the replies were the following statements.

Mr. Aspinwall said: "Any form of automatic continuous brake should be capable of being applied by the conductor on all vehicles, as well as by the engineer."

Mr. Ely: "In a general way, I would say that as the traffic on our principal roads and the speed at which the trains are run have so greatly increased as to require extraordinary facilities for controlling the movement of trains, and as these facilities are, so far as we know, limited to the weight of the equipment, the retarding force should be applied to all available parts of the train, and so make the braking power of the equipment most effective in case of emergencies; it should be kept in daily use."

Mr. Atkinson: "The application of brakes by conductor should be as rare as possible, and should be subject to gradation exactly as by the engineman, so that he need not and should not apply the whole force unless in emergency; there is then no objection to the conductor's power of applying brakes extending to the tender and engine, but it is rather beneficial than otherwise, as he could not strain the couplings behind the tender. Of course the engineman would detect the application almost instantly and would shut off steam."

Question No. 9.—"Is there any danger in using a powerful brake at front end only?" was asked with the intention of finding out if the opinion held by some and well expressed by W. S. Huntington (see letter in NATIONAL CAR-BUILDER, February, 1885) was a general opinion. He says: "When a train is running down a long grade on a curve, and no brake power is available in the middle and rear portions, powerful application of the brakes to the locomotive and a few of the forward cars causes the flanges of the wheels upon which no brakes are acting to be thrown forcibly against the outer rail, causing mounting and spreading of the rails and derailment. This is the natural result of centrifugal force combined with the suddenly checked momentum of the cars not held by brakes and having no hold on the rails other than the ordinary rolling friction; that is to say, the portion of the train that is suddenly checked is a dangerous obstruction to cars that are not held by brakes, by reason of their tendency to crowd each other past the obstruction in a tangent, assisted by momentum and centrifugal force."

Also, it is noticeable that many cases of derailment occur when an engine is not working steam; especially is this the case with six-wheel-coupled truckless engines, moving round sharp curves. Engines will go safely over a quick curve if exerting a pull, that cannot be certainly counted upon to keep the track if propelled in front of some other motor; and even on straight track, few rail-road officers will permit the backing up of a train in advance of its engine, and there is legislation forbidding trains being run with engine having tender first.

The explanation for this may not be single or simple in character, but it would appear as if the internal propelling power must be greater than the internal and external resistance combined, to insure safety under the given conditions. If driver brake, and that only, is applied, the mass of the train will then give the forward momentum, or be the propelling power, and the engine wheels will give the frictional resistance in front of the power, subjecting them to possible derailment. This is apparently an element of danger; but whether the hypothesis be a correct view of the case or not, it is satisfactory to find not a single case of trouble due to the application of driver brake only is recorded in the answers received, while 18 state definitely that in their opinion there is no danger, Mr. Worsdell adding, "especially when cars are coupled slack." Mr. Aspinall believes there is danger if application is sudden, and he uses a smaller air ejector to obtain a vacuum on freight engines. Mr. Cushing says: "On engine alone there is an element of danger except used with care, * * * * especially if considerable slack in couplers."

What percentage of the total weight of the engine can effectively and safely be utilized for brake resistance? If there is no risk

or danger in locating a powerful resistance forward of the moving body, no attention to this question is necessary, unless the brake is automatic in application when train separates. In considering this latter case, it should be remembered that it is not judicious, in arranging the lever proportions for any cars, to count upon utilizing more than the tare or empty weight; otherwise, if arranged to take advantage of the increased weight when more or less loaded, then if brake blocks be applied to wheels when car is actually empty, the effect would be to promptly skid them. Hence, if the engine brake is designed to utilize the whole of the weight of engine and tender, and the detached cars in rear be heavily loaded, the latter will, after the brakes have gone on automatically, move with a higher speed than the front end and eventually collide. Such a rear pile-in could only take place when the brakes on engine and front cars are utilized for resistance to motion, a greater percentage of the total dead weight resting on the braked wheels than was utilized on the rear portion. Some engines have blocks on all wheels—and tank engines lend themselves readily to such an arrangement—but cars should be taken to arrange the leverage so as not to utilize the whole insistent weight if the application is to be automatic.

To the somewhat crude question of what percentage of weight on drivers should be utilized, one reply says 7 to 10 per cent.; another, 45 on engine and tender, with 100 on cars; a third, 50 to 60; a fourth, 80; a fifth, 75 to 90; a sixth, 95; and a seventh says twice the weight on drivers, or 200. Captain Galton's experiments—which are now classic—prove that speed is the most important factor in this equation, 200 per cent. being safely used at high speed of 50 or 60 miles per hour without skidding the wheels; but the pressure must be lessened as the speed lessens, if skidding is to be avoided.

In the matter of brake-block shoes, their substance, size and shape, 6 are in favor of cast iron, 7 of wrought iron, and the American Co. say 95 per cent. are of wrought iron; 2 approve of the Congdon, while 1 prefers wrought to Congdon. Mr. Webb says: "The best results we obtain" from wood blocks when they can be "conveniently" applied. Those we have in "ordinary" use are of English poplar, about 18×3½ in.; the face is perforated with fine 1⅛ in. holes, which are afterward filled with a "mixture of resin and sand," and Mr. Johann, while preferring wrought iron, has obtained excellent results from a head filled with hard wood blocks, as per drawing No. 1, attached. The Eames Co. says: "That material is to be preferred" which yields the quickest stop, with due "regard to economy, durability and effect upon" the wheels. Cast iron presents a greater "frictional resistance than wrought iron, much as it granulates and retains a certain degree of roughness throughout" all life of the shoe, instead of becoming smooth and polished, as in the case with wrought iron.

"The wear upon the tires is undoubtedly greater with the cast iron than with wrought iron, but this is the necessary result of its greater braking efficiency. The more effective the brake, the greater the wear of both shoe and tire. The same principle of efficiency applies to the comparative cost of the two materials. The wrought iron shoe has a longer life, and independent of the work performed is cheaper; but when the actual braking power furnished by each is taken into account, cast iron is the most economical."

As to amount of surface, the American Co. averages 60 sup. in.; 2 replies give a maximum of 88 in., and 1 a minimum of 36 in., or a difference in length varying from 22 in. to 9 in. The Eames Co. say they "favor the greatest length of shoe that can be conveniently applied. The longer the shoe, the less frequent the replacement; the frictional resistance being the same whatever the length of shoe, the greater the surface of the shoe, the greater the distribution of the wear and consequent life of the shoe. The same principle applies also to the thickness of the shoe; the thicker, the greater the durability. As a matter of practice, having regard to all these points, we make our shoes of a length equal to three-fourths of the radius of the wheel. * * * Our experience is opposed to the use of double shoes because of their liability to cut into the tire. But it is an advantage to have shoes fixed well over the flanges," and five replies indorse this latter statement.

What is the position of block giving greatest efficiency and least interference with the elastic freedom of springs?

Mr. McCrum sends a blue print showing position at angle of 24°, or with block 22 in. long the top is 2½ in. below centre of wheel.

Mr. Cook says toe of shoe should clear rail 4¼ in.

The reply of five is top of shoe should coincide with center, and two say center of block and of wheel should coincide. Many accept the positions given by the brake companies without question, and these being familiar to all need not be specified. Mr. Atkinson says: "The wedge type should be 45° from vertical, as if too high, they tend to throw the pressure on the side of the brass where the blow and wear from the steam thrust takes place. * * * * The application of one block at side of wheel interferes with the action of the spring in the proportion that it is effective; the compression type with blocks directly opposed interferes least with spring action. Single blocks on top of wheel would carry part of the load, and thus interfere with spring elasticity; if placed on the center of the rising side, would tend to act similarly in decreasing load on spring; while, if on the falling side, would tend to increase the load on spring. The committee generally indorse Mr. D. Clarke's statement, that they should be as much below center as possible, allowing safe rail clearance.

The modes of applying blocks, their number, their position and the choice of wheels they are applied to, is legion. Haswell, of Vienna, on a 10-coupled tank-engine, in 1862, tried blocks on the top of the second and third only. Apart from the question of interference with spring-action, it is a fair inference that the inner qualities of rail surface severely tested the brake-rigging, despite the fact that the power was given through the elastic medium of two steam-pistons.

An examination of 110 drawings showing engines equipped with driver-brakes gives the following analysis, viz.: 37 are wedge type—ties in part, and 6 force adjacent axles; 10 are of the compression or grip type, with blocks on both sides of one or more wheels, and 6 compression type on opposite side of coupled but not adjacent wheels; 45 with one or more single blocks in front of wheels (block in going on moves backwards), and 2 with one or more single blocks at back of wheel (block in application moves forward). Many of these drawings represent shunting and tank-engines, and 17 have every wheel—drivers or carriers—provided with brake-shoes.

Many attempts have been made to obtain a driver brake through resistance offered to piston movement, without the destructive effects which commonly accompany steam reversal. Closed exhaust nozzles have been used, so arranged that piston had either vacuum behind or excess pressure in front, and even compressed air has been admitted in front of piston. The most successful of these schemes—one that has been at work for 21 years, and which continues to be applied to new engines on the French and Belgium railways—is the counter-pressure brake of L. Chatellier, which achieves its resistance—after the reversing lever is thrown over—by the interposition of a small jet of boiler water from an opening of $\frac{1}{10}$ to $\frac{1}{8}$ sqr. in. area, delivering from 8 to 40 lbs. of hot water per minute in the cylinder exhaust passages, which on release flashes into wet steam, and being drawn into cylinder by piston, cools the metal it comes in contact with; the general tendency of other counter-pressure brakes being to heat and cause excessive friction between the moving parts. If sufficient water is admitted part of this steam escapes from the exhaust nozzle, thus fully insuring that from smoke-box no dust shall be drawn into contact with bright metal faces, or gases drawn in and then forced into boiler. A small brass valve and a 1¼ in. pipe are the total equipment required for this brake, which is very effective in checking speed and keeping cylinders well lubricated on down grades, and it can be relied on for instant application as long as there is hot water in the boiler. The earlier attempts to inject steam instead of water were not successful, and even mixed steam and water called for too much discretion in application to insure its extensive use.

Mr. Cushing uses driver-brake on long grades only as auxiliary, their tendency being to heat and and loosen the tires, and it is for steadying on long down grades that counter-pressure has proved so effective.

A handy, effective and well-arranged steam driver-brake—open it is believed to general use—as designed by Mr. H. Wallis, for shifting and branch engines on the Grand Trunk Railway.

Mr. Gurney, agent for the Beal brake, forwarded drawings illustrating the application of that patent. It will be noticed that by a neat arrangement of fixed and floating levers with single connecting bars (which can be of small section, as they do work in tension only), the shoe pressure is put in equilibrium through-out, and as the shoes clasp the wheels, the strain either on frames or machinery is very light. New shoes replacing those worn out can be slipped into place any time without disturbing, to any great extent, the equality of pressure throughout the series, and the single series may include both tender and engine wheels. The parts are light, easy to manufacture, and largely duplicate for tender and engine, as well as for different classes of engines.

Our thanks are due not only to members, but to the following gentlemen and firms, who, although we had no legitimate claim upon them, kindly contributed information, drawings, etc., viz., the

American Brake Co.,
J. A. F. Aspinwall, Great Southern & Western Ry. (Ireland),
R. Atkinson, Canadian Pacific (Canada),
R. Boag, Grand Trunk,
Eames Brake Co.,
T. N. Ely, Pennsylvania Railroad,
W. B. Gurney,
H. Roberts, Chicago & Grand Trunk Ry.,
C. Sacre, M. S. & L. Ry.

H. A. WHITNEY,
J. DAVIS BARNETT, } Committee.

Mr. Barnett favored the use of driver brakes, and considered them a useful auxiliary in controlling the speed of trains. He considered them perfectly safe.

Mr. Whitney asked what the experience of members had been as to the wear of journal and side-rod brasses where driver brakes were used? They used brakes between the wheels and found no trouble in this respect.

Mr. Lauder could not give accurate data, but he doubted the propriety of using driver brakes for making ordinary stops. Believed the driver brake should be used only in cases of emergency. They had equipped all their engines with driver brakes, but he thought they should be reserved for sudden stops. Their use in this way had saved them several accidents.

Mr. Ball said on the elevated roads, where there are many stops, the engineers had used the driver brakes for making ordinary stops, and it caused breakage of driving axle boxes. The bushing on the side-rods also wore very fast. They now use them as an emergency brake alone.

Mr. Johann began using driver brakes twelve years ago. Had used them for ordinary stops and found no trouble with axle-boxes or side-rods. Thought all engines ought to have driver brakes.

Mr. Whitney used driver brakes for making all stops and considered that the proper way to do. Brakes must be used to stop a train promptly, and he regarded the heaviest vehicle on the train, which was the engine, should be called on to the heaviest braking. He also favored making the driver brake automatic, so that it might be applied from the train in case of emergencies.

Mr. Shafer believed driver brakes should be used for all stops. He had no more trouble with driving boxes and side-rods on engines having driver brakes than with those that did not have them.

Mr. Sinclair said several years' experience handling a driver brake led him to the conclusion that to use them tended to prevent tires forming a double flange; but that it increased the wear of driving-box brasses and side-rod brasses.

Mr. Ball: On most of our engines the brake is placed between the drivers and jams the wheels apart. Thinks the arrangement bad. On the Brooklyn Bridge they have engines with driver brakes applied to both sides of the wheel, which causes no disturbance. Mentioned a case where a flat spot was ground off a tire by use of the driver brake.

Mr. G. Hackney said they were using the Chatelier brake on the mountain grades of the Atchison, Topeka & Santa Fe road. There they used the driver brakes all the time in connection with train brake. When they tried to use the driver brake merely for emergencies, they found it was not in order when wanted. The Chatelier brake is of great service on a grade they have of 187 feet to the mile and 9 miles long.

Mr. Barnett said the Chatelier brake was used on the Canadian Pacific, and was highly valued.

Mr. Ettenger said they had recently adopted driver brakes, and he made their action on the engine parts a matter of careful investigation. He could not find any appreciable difference of wear due to the use of driver brakes, although he watched engines with and without such brakes that were doing the same work.

After a little more discussion the subject was dropped.

THIRD DAY'S PROCEEDINGS.

REPORT OF THE COMMITTEE ON BALANCED SLIDE VALVES.

To the American Railway Master Mechanics' Association:

The committee appointed to report on balanced slide valves beg to submit the following as the result of their inquiries. A series of questions bearing on the subject and prepared by your committee were printed and distributed by your secretary to members of the association. In addition, a limited number of circulars were forwarded to Europe, and addressed to the leading locomotive superintendents of Great Britain, all of whom promptly replied to the questions asked. It is a curious fact that the replies from the other side of the Atlantic were, with one exception, all unfavorable to the use of balanced valves, whereas the answers received from American master mechanics showed that balanced valves as applied by them generally gave little or no trouble, and were considered successful. It may not be out of place to here mention that the earliest application of balanced slide valves reported to your committee was made in 1844 to engines on the Grand Junction Railway, now a portion of the London & Northwestern system of England.

In reply to your committee's questions Nos. 1 and 2, namely, "with what balanced slide valves for locomotives have you had experience; please send sketch or drawing of same; upon how many engines were these valves applied; give date when the first of each description was placed in service," the following replies were received:

Mr. John Davis Barnett sends blue print representing valves as used on the Grand Trunk Railway of Canada, and generally known as the improved Morse pattern; 204 engines are now equipped, and the number is steadily increasing. The first was applied about nine years ago.

Mr. Allen Cooke reports having used a Richardson valve and the old Morse valve on the Chicago & Eastern Illinois Railroad, the Richardson valve being applied in January, 1883.

Mr. D. Drummond states that the Adams valve was used on the Caledonian Railway of Scotland, but gradually abandoned 15 years ago.

Mr. W. H. Harrison reports the Baltimore & Ohio Railway Company having 135 engines equipped with the Beckert and one with the Richardson valve. The first were applied in April, 1885.

Mr. Thomas Jones used the Adams valve on the Highland Railway of Scotland.

Mr. J. Manson states that the Adams valve is used on many of the outside cylinder engines of the Great North of Scotland Railway.

Mr. J. Meehan reports having used the Richardson on 19, the Delancy on 31 and Margach's balanced valves on 41 engines of the Cincinnati, New Orleans & Texas Pacific Railroad, the first of the Delancy valves being placed in service in October, 1884.

Mr. Harvey Riches states that he has some balanced valves in operation on the Taff Vale Railway of England, but gives no further particulars.

Mr. C. E. Smart reports having used the Richardson valve on 18 engines of the Michigan Central Railroad, the first being applied in March, 1885.

Mr. Geo. W. Stevens has used the Richardson and the Margach valves on the Lake Shore & Michigan Southern Railroad.

Mr. W. H. Stevens has 26 engines equipped with the Richardson valve on the Connecticut River Railroad. The first was applied in June, 1882.

Mr. P. Stirling, of the Great Northern Railway of England, states that he has used three different kinds of balanced valves, but does not describe them.

Mr. W. Stroudley, locomotive superintendent of the London, Brighton & South Coast Railway, states that he used the Adams valves on outside cylinder engines of the Highland Railway of Scotland in 1866.

Mr. Thos. B. Twombley, master mechanic of the Chicago, Rock Island & Pacific Railway, reports that he has about 150 engines equipped with the Morse valve, first applied in 1880.

Mr. F. W. Webb, locomotive superintendent of the London & Northwestern Railway of England, states that he has one pair of experimental valves in use at the present time, and also that several engines were equipped with balanced valves, as per blue print exhibited, in the year 1844.

Mr. William Woodcock reports that he has, on the Philadelphia & Reading Railroad, 12 engines fitted with the Allen valve balanced by the Richardson device, the first having been applied in February, 1882, and has also used the Bristol roller valve.

In reply to question No. 3, "If you have had experience with more than one kind of balanced valves, please state which you consider on the whole the most satisfactory and name the good and bad features of each valve," the following answers were received:

Mr. J. Davis Barnett reports that his experience is limited to three types (1) the ordinary slide valve with a cylinder cast on steam chest cover and in which piston works, coupled by pendulum connecting rod to back of valve. This, which has been tried in all varieties and forms for the last 30 or 35 years, was not a success. (2) The Adams annular balance on back of valve. This is defective by reason of the ring occasionally canting and immovably locking the valve, so that either valve buckle, stem, or some other part of motion gets broken. Or conversely the ring dropping down, the blow-through of steam is excessive.

Mr. D. Drummond, Caledonia Railway, supplies tracing here exhibited showing extreme travel of valve when the train is under different conditions of load. A ridge was found to be formed at two parts of the seat, and caused a considerable blow of steam when piston of the Adams rode over the ridges at extreme end of the travel corresponding to third notch of reverse lever, a position in which engines were probably mostly worked. The valves were abandoned on account of this difficulty and on account of the trouble they gave at outside stations, in keeping them clean and in good working order, making the expense of their maintenance greater than that of the ordinary valve. Mr. Drummond refers to the piston balanced valve introduced by the late Mr. Beattie on the London & Southwestern Railway, but which had to be abandoned on account of the difficulty in keeping it tight.

Mr. Harrison considers the Beckert valve as more satisfactory than the Richardson on account of its simplicity, ease of application and cheapness. So far, this valve has not developed any bad features.

Mr. D. Jones gave up the Adams valves on account of their losing so much steam by blowing past the piston rings of the valves.

Mr. J. Manson states that speaking generally the results obtained with the Adams valve on the Great North of Scotland Railway are most favorable, so much so that since taking up his duties as locomotive superintendent he has increased the number of engines fitted with it, and is still adding to the number. A tracing of the valve, as used by Mr. Manson, is here exhibited.

Mr. James Meehan presents the following as opinion of his Division Master Mechanics Tomlinson and Fowle: The former states that "of the Richardson, Delancy or Margach valves, I have had more experience with the Richardson, and consider it, if carefully proportioned and fitted, to be a fair balance, and owing to its extreme simplicity, well suited for passenger engines. I do not think that if properly constructed and cared for there are any bad features worth mentioning. The Delancy I have not seen applied to passenger engines, but on freight I consider it a first-class valve. Have had three engines running with it on my division for four months but have never had occasion to touch the valve. My objection to this valve is a large amount of suction when steam is shut off, necessitating cutting the engine back when running light, and having a tendency to, in my opinion, increase the necessity for lubrication. My experience, however, has been with valves when new, and it is possible, when worn free, that this trouble may not be so apparent. The valve is of good construction, and if suction, or the compression of air in steam-chests can be reduced, it should be a good valve on fast as well as slow working engines. It gives, so far as my experience goes, no trouble. The Margach valve is, in my opinion if well constructed, as good a balance as any of the three I have described, as there is no wearing against the steam-chest cover or false upper seat when steam is shut off. Its bad features are the tendency of the nuts securing the balance pistons to valve to work loose and of the balance rings to stick or gum up, unless great care is taken to keep them clean. If this valve is well made and properly applied it should make a good balance and can be used without relief valve."

Mr. T. W. Fowle, Division Master Mechanic, states: "I consider the Delancy valve the most satisfactory of the three. The good features of the Margach valve are that the rings are held up against the chest-cover by steam pressure only, and if the rings get gummed up or bound in any way it causes a bad blow on starting the engine. The friction caused by the rings coming in direct contact with the chest cover makes them wear very fast where they are fitted to the valve, and which necessitates frequent renewal. The bad features of the Richardson valve are that the packing strips come in contact with the chest cover, and the friction soon works the strips loose in the grooves in valves, making repairs necessary. The springs for holding up the packing strips sometimes break and cause a bad blow. With these exceptions, I consider the Richardson a splendid valve. The packing strips in the Delancy valve have no wearing surface, therefore give no trouble and do not have to be renewed; but we have the same trouble from occasional breaking of springs which hold up the packing strips that we experienced with the Richardson valves. Aside from the springs breaking, the Delancy valves give no trouble whatever."

Mr. George W. Stevens prefers the Richardson to the Margach valve on account of the former running a greater length of time before requiring repairs and thus crippling the engine, than the other.

Mr. William Woodcock prefers the Richardson balanced valve to the Bristol valve, as the latter is very difficult to adjust and expensive to keep in order. He states, "I have not furnished any data in reference to the Bristol anti-friction roller valves. This style of valves was put on four engines when completed in 1868 and have been continued to the present date. When put up in good shape and properly adjusted they work very satisfactorily for probably about an average of 15 months, they then will require repairs, the rollers and strips upon which the rollers trave

become worn and all have to be repaired and adjusted. All things considered, I consider the Richardson balanced device the best that we have tested or have any knowledge of at the present time."

To the question, "What is the cost of these balanced valves and necessary adjuncts per engine, compared with the ordinary valve," the following answers were received:

Mr. J. Davis Barnett states that if standard sizes are adopted throughout and milling tools used on the work, the total extra cost per valve will not exceed $5.

Mr. Allen Cooke states that the first cost of equipping an engine with the Richardson balanced valve is about as much again as with the common valve.

Mr. Harrison states that it costs $12 per engine to apply the Beckert attachment to the old style of valve. With the Richardson valves he is compelled to make new yokes and have the balance plate under steam chest cover. With the Beckert valve nothing is required but to plane off inside face of cover and top of old valve.

Mr. Meehan, through Division Master Mechanic Tomlinson, states that the cost of each of the three valves used on his road is about double that of the ordinary D valve, the Margach probably being the most expensive, and the Richardson the cheapest, royalty being equal.

Division Master Mechanic Fowle agrees with Mr. Tomlinson as regards the relative price of balanced and ordinary D valves.

Mr. C. E. Smart states that the Richardson balanced valves and necessary adjuncts cost nearly four times as much as the ordinary slide valves.

Mr. Thomas B. Twombley states that the cost of the balanced valves as used by him over that of the ordinary valve is about $18 per engine.

Mr. William Woodcock reports the cost balanced valves per engine to be $90 and that of ordinary valves $10.

To the question "What is the average cost per engine per annum of maintaining these balanced valves and their seats; give figures applicable to each 12 months after valves were placed in service until their renewal was required; give similar figures in the case of ordinary valves on the same class of engines and, if possible, mileage made each year," the following answers were received:

Mr. Barnett states that the cost is variable; that he has run for two years without breaking a steam-chest joint and at other times springs have had to be renewed within a month or two. He estimates the average cost of maintenance to be not more than $3 per valve.

Mr. Cooke reports the costs of repairs for two years and 11 months in the case of engine 42, fitted with Richardson valve, $4.50, and which was for one facing the seats; he states that with the ordinary valve seats require to be faced every five to seven months.

Mr. Harrison states that none of the Richardson or Beckert valves have been running a year, but up to the time of his report the cost of maintaining the Beckert valve had been comparatively nothing. The Richardson valves had seats of left cylinder faced off three times since it was put in, and had balance strips broken in two once.

Mr. Meehan, through Division Master Mechanic T. W. Fowle, reports that the average cost per engine of maintaining the balanced valves the first twelve months after they were placed in service was $1. He has no engines of the same class equipped with ordinary valves and is unable to give cost of their maintenance.

Mr. George W. Stevens states that from observation it is quite evident that the cost of maintaining the Richardson valve will not exceed that of the plain valve.

Mr. Twombley reports the average cost of maintaining the valves as used on his road to be $8 per annum; that of the ordinary valve $10.

Mr. Woodcock reports cost of facing seats and valves at $5.

To question 6, "What mileage is represented by one-fourth inch wear of valve seats of similar engines when using and when not using the balanced valve, and state if vacuum valves were used in each case on steam chests," the following information was received:

Mr. Allen Cooke reports placing Richardson balanced valves on engine No. 42, a Mogul with 18 by 24 in. cylinders, on Jan. 10, 1883. On Aug. 13, 1884, after running 50,922 miles with freight trains, and hauling 42 loaded cars in summer and 36 in winter, the valve seats were faced, the wear having been one sixty-fourth of an inch; the engine then ran until the 31st of December, 1885, making 44,925 miles additional, when she was shopped on account of accident, but required no work to valve or seats, neither to links, pins or valve gear, as there was no lost motion to be taken up.

Mr. Meehan's division master mechanic, Mr. Fowle, states that during the 15 months his Mogul engines have been in service with the Delancy valves he has not had occasion to face a single valve, and they are all now in first-class condition, and not one of them will show one thirty-second of an inch wear.

Mr. Woodcock has supplied the following tabular statement, showing in the case of 10 passenger engines engaged in high-speed service and equipped with Richardson-Allen valves, that one thirty-second of an inch wear of the valve seats was the result of an average mileage of 41,663 miles and ranging from 24,311 to 65,542 miles.

STATEMENT SHOWING WEAR AND SERVICE OF ALLEN VALVE WITH RICHARDSON'S BALANCING DEVICE AS USED BY THE CENTRAL RAILROAD OF NEW JERSEY.

Eng. No.	Dimensions of cylinders. Inches.	Valve put in.	Valve seats faced.	Wear. Inch.	Mileage to 1-32 wear.	Total mileage.	Remarks.
162	19 x 24	Oct. 3, 1882	9-24-84 and 12-25-85	1-16	28,925	57,850	These engines are all in passenger service high speed.
163	19 x 24	Apr. 30, 1883	6-25-85	1-32	44,616	44,616	
164	17 x 24	Jan. 10, 1885	9-14-85	1 32	32,075	32,075	
165	17 x 24	July 24, 1882	4-26-83, 10-23-83 and 7-17-85	3-32	40,372	121,116	
168	18 x 24	Nov. 22, 1882	2-15-84 and 12-10-85	1-16	46,220	92,441	
169	18 x 24	Feb. 24, 1883	4-5-82 and 4-7-85	1-16	65,542	131,083	
172	18 x 24	Mar. 5, 1883	10-2-85 and 2-20-86	1-16	54,146	1 8,292	
173	18 x 24	Apr. 14, 1883	10-3-83, 12-29-85 and 1-18-86	3-32	24,811	74,433	
174	17 x 24	Feb. 7, 1883	9-26-83, 4-1-84	1-8	30,555	122,220	
175	17 x 24		9-8-84 and 9-28-85 2-12-84	1-32	40,375	40,375	

Average mileage to 1-32 in. wear of valve seats, 41,663.

ELIZABETH, N. J., May 5, 1886. WM. WOODCOCK, Master Mechanic.

He states that before the application of balanced valves to this class of engine it was generally found necessary to face the valve and seat after running an average of 600 miles, with a wear of from one thirty-second to one-sixteenth of an inch. He thus increased the life of valves and seats by the use of balanced valves from 700 to 1,400 per cent., at the same time saved the cost of facing them and kept the engines in continuous service, so far as the valves and seats were concerned.

To questions Nos. 7 and 8, "When packing strips are used what width should they be to give best results; should they and the grooves in valves be fitted by scraping, or will planer and milling machine make a sufficiently good finish?" "When springs for holding up the packing strips are used, what kind gives best results?" the following answers were received.

Mr. J. Davis Barnett states that grooves in valves could not be cut by planer, as the work is not satisfactory or dead true, but if finished by two cutters with three working faces on milling machine, no hand work is required. He uses coiled steel springs two and one-sixteenth inches long, five-eighths inch outside diameter of No. 15 B. W. G. round steel, coiled to five-thirty-seconds of an inch pitch, which proved satisfactory.

Mr. Allen Cooke uses packing strips nine-sixteenths of an inch thick and flat steel springs he fits by scraping, but thinks that a perfect milling job would do very well.

Mr. Harrison is of opinion that seven-sixteenths of an inch packing strips give the best results and considers spiral springs to be preferable. He states that the rings used in the Beckert valves do not require any scraping, but merely turned up to fit inside, allowing one-sixteenth of an inch outside for steam.

Mr. Meehan, through Division Master Mechanic Tomlinson, states that he considers packing strips should be from three-fourths to seven-eighths inch deep, by one-half inch to five-eighths inch wide. He considers scraping unnecessary, and prefers hair elliptic springs one-sixteenth of an inch narrower than the strip and one-sixteenth inch in thickness, if well tempered, for keeping the strips up to their work.

Mr. Fowle states that packing strips three-fourths of an inch square give the best results. The strips and grooves need not be scraped; the planer and milling machine will make a sufficiently good finish. Elliptic springs made of five-eighths by one-sixteenth spring steel give better results than any other kind he has tried.

Mr. Smart considers that half an inch in thickness is sufficient to give good results and that planing or milling if perfectly done will make a sufficiently good finish. He prefers half elliptic springs for the purpose of holding strips up against steam-chest cover.

Mr. W. H. Stevens says that he thinks planer and milling machine will answer, and that he uses flat steel springs for holding up the packing strips.

Mr. Twombly states that the strips used on his valves are nine-sixteenths of an inch wide; the sides of strips and grooves in valves are not scraped, but the strips are fitted to the inside of steam chest-cover by scraping, both strips and cover being finished in this manner. He uses flat steel springs of semi-elliptic form.

Mr. Woodcock prefers close machine fits to scraping, and uses flat steel springs for holding up the strips.

To question No. 9, "What increased life of valve gear is attained by using balanced valves; does it thereby reduce the cost of engine repairs to an appreciable extent?" the following answers were received:

Mr. John Aspinwall, locomotive superintendent of the Great Southern & Western Railway of Ireland, states that he has recently been carefully investigating the question of the friction of locomotive slide valves, but having sent the manuscript containing the result of his observation to the Institution of Civil Engineers in London, he is not at liberty to make use of the information until it has been published by them. He states, however, that he has found the friction to be somewhat less than is generally supposed, so as to make it very doubtful as to there being any economy in using balanced valves.

Mr. Barnett answers in the affirmative, but has no records whereby he can give more definite answer.

Mr. Allen Cooke states, "It is a great paying investment in regard to valve's motion, easy working of engines and saving in fuel."

Mr. Drummond, of the Caledonian Railway, states that the present manager of the Saint Rollox works had charge of the experiment with the Allen valve, and informs him that there was no saving by their use either in fuel or in tear and wear of valve gearing, and were consequently gradually given up.

Mr. Harrison considers the life of the valve gearing to be increased about 75 per cent. by using balanced valves, and the cost of repairs to engines is reduced considerably.

Mr. Jacob Johann, master mechanic of the Chicago & Atlantic Railway, states his experience with the modern style of balanced slide valve to be very limited, but he is well satisfied that a well-constructed balance valve is a decided advantage in the operation of a steam engine.

Mr. Meehan, through Mr. Tomlinson, states that the saving by the use of balanced valves appears most in the increased life of pins throughout the link motion, as also in the blocks and eccentrics, and this he places at a saving of 50 per cent.

Mr. Fowle places the saving of valve gear by the use of balanced valves at 100 per cent. He states that during the 15 months that his Moguls have been in service he has not had occasion to face a single valve, and they are all now in first-class condition, not one of them showing one thirty-second of an inch wear.

E. M. Roberts, master mechanic Ashland Coal & Iron Railway Company, reports that a piston balanced valve, fitted to one of his engines, has proved an unqualified success, being a perfect balance, and so reduces the friction that reverse lever can be moved with throttle wide open as readily as when steam is shut off.

Mr. Smart states that the length of service would not justify him in giving a decided answer, but is of opinion that it will increase immensely the life of the valve gear.

Mr. Stirling, of the Great Northern Railway, states that he tried three kinds of balanced valves without success; in each case the consumption of fuel was greatly increased by the inevitable leakage, even when they were quite new and in the very best condition. He has not thought of balancing for years, and has not a single set of balanced valves at work.

Mr. Stroudley, of the London, Brighton & South Coast Railway, states that he paid particular attention to the quantity of oil used by engines fitted with the Adams valve, as compared with those working with the ordinary slide valve, and found that the quantity used with the balanced valves was considerably greater; also, that it made no appreciable difference in the consumption of coal. "You could, however," he states, "when the engine was working at 140 pounds pressure, regulator wide open, hold the lever in one hand when standing square across. In fact, you could reverse the engine into back gear to and fro with one hand quite easily, almost as readily as though the steam were shut off."

Mr. Twombly states that increased life of valve gear equal to nearly 100 per cent. is obtained by his company in using balanced valves, and their use does reduce the cost of repairs to an appreciable extent. As an instance, Mr. Twombly states that one of the first engines on which these valves were placed, No. 243, has been running on heavy passenger service for six years, and not a pin in her link motion has been replaced. This would be impossible with unbalanced valves.

Mr. Woodcock answers this question in the affirmative, but has no data to offer.

Mr. Jones, of the Highland Railway, has furnished your committee with tracing, showing the standard valve used on that road. In explanation he states that the holes are not filled with any kind of metal, and apparently are intended for the purpose of reducing the pressure between valve and seat. He states that his engines with these valves work up and down grades of 1 in 70 and 15 miles in length, the daily run being 144 miles with express trains in four hours, stopping seven times during the journey, and climbing 1,500 feet, valves being made of cast iron.

Mr. Stroudley states that on the London, Brighton & South Coast Railway he has about 410 engines with the ordinary valves, and they are usually faced up every 6 to 12 months. He says: "We face them by hand and pay 20 shillings per engine for doing it. We use in some engines cast-iron valves; in others, ordinary bard brass and in some phosphor bronze. Where the cast-iron valves happen to suit the metal of the cylinder, they appear to work the best of any. Next in order comes phosphor bronze. It appears to work beautifully under any circumstances, those of ordinary brass having about two-thirds of the life of a phosphor bronze valve." He also states that on the Highland Railway, which has long inclines, engines run as many as 15 or 20 miles at a stretch without steam; he is of opinion that in such circumstances a balanced valve that will not fall away from the face will not work satisfactorily, and the saving to be gained by balancing will not, in his opinion, pay for the complication necessary to effect it.

Mr. Woodcock reports that previous to the application of the Richardson valve, and when using plain valves, he usually found it necessary to face valve and seat after running an average mileage of 6,000 miles, with a wear of one thirty-second to one sixteenth of an inch. At this rate the seats would have soon been worn out. It therefore became a serious matter and necessary to provide a remedy to prevent this increase of wear of the seats, and after a test of one set of the balanced valves he was satisfied that he had overcome the difficulty. He believes that this was the first Allen valve balanced with the Richardson balancing device, and was placed on engine No. 162.

The valves most favorably reported on appear to be the Richardson, the Delancy, the Morse, as used by Mr. Twombly; the Adams, as used by Mr. Manson on the Great North of Scotland Railway; also, the Beckert valve, as used by Mr. Harrison on the Baltimore & Ohio Railroad. The latter, although well spoken of, has been so short a time in the service—about one year only—that it is impossible to say how it will eventually compare with its competitors.

Attention of your committee has been called to the Reaser and the McDermott valves, but no official report of their trial on locomotives has been received. The information furnished is, we consider, sufficient to warrant your committee reporting favorably on the results obtained with several makes of balanced slide-valves, and above referred to. They are especially of service on engines with steam-ports necessitating slide valves of large dimensions; the consequent reduction of friction due to the load being removed from the slide-valves results in very much increased life of the valve-seats, valves, pins, blocks and all other connections of the link motion, as notably described by Messrs. Twombly and Woodcock. By their use engineers are enabled with ease to regulate the distribution of steam in the cylinders by means of the reverse lever without shutting off, a matter of no little importance in the case of heavy trains on long, steep and continuous grades.

Your committee suggest the desirability, in future, of keeping account of the mileage made, wear of the seats, etc., as done by Mr. Woodcock. This will enable comparisons to be made, and will prove of much interest to the association when the subject is next brought to the front. The diameter of driving wheels should also be noted.

This opportunity is taken to thank members of the association and to place on record that due to British locomotive superintendents, for the information furnished your committee for this report; the whole of which is respectfully submitted.

CHARLES BLACKWELL,
Committee.

Mr. Meehan had nothing new to add beyond what had been sent to the committee. He is using several kinds of balanced valves, and is impressed very strongly with the advantage derived from using a device of this kind. The balance valve saves wear of seats and increases the durability of the motion.

Mr. Blackwell called on Mr. Woodcock to give more particulars about the Richardson balanced valve, which had increased the wearing qualities 1,400 per cent.

Mr. Woodcock said that before using the balanced valve they had to face the valves every six weeks. Since it was applied, their fast engines ran from 16 to 18 months without facing. All their fast passenger engines now had balanced valves, and he was in favor of extending their use.

THE BEST PLAN OF REMOVING, CLEANING AND RESETTING FLUES.

To the American Railway Master Mechanics' Association:—Your Committee, to whom was referred the subject of "The Best Plan of Removing, Cleaning and Resetting Flues," would report that they issued the following circular of inquiry to all members of the association:

"The undersigned have been appointed as a committee to ascertain the best plan of removing, cleaning and resetting flues, and respectfully solicit answers to the following questions:

"First—What, in your opinion, is the best method of removing flues? Please describe in detail.

"Second—Have you ever removed flues by the aid of a locomotive or other power? If so, please give experience.

"Third—Does the manner in which flues are set affect the plan of removal? If so, how?

"Fourth—What do you consider the most economical and thorough way of cleaning flues after they have been removed from boiler?

"Fifth—What have you found to be the best manner of resetting flues?

"Sixth—What material do you consider best for flue ends?

"Seventh—Have you found it more satisfactory to weld or to braze ends to flues?

"Eighth—Does the character of the water or fuel used in any way govern the manner of doing above work? If so, please state in what particular?

"As far as possible, please send with your report drawings or sketches giving dimensions of all special tools or devices.

"That the Committee may be enabled to make as complete a report as possible, and one analyzing the subject under all conditions, they would request members not to confine their reports to direct replies to questions, but give all information obtainable."

We have received answers, all more or less complete, from 12 members, as follows:

Question No. 1—What, in your opinion, is the best method of removing flues? Please describe in detail.

Answer—Four cut-off flues inside of front flue sheet. Two members report that if flues are not badly scaled, his practice is to turn down the bead in the fire-box end and drive them out. If scale has formed on them to such an extent as to prevent their removal readily, take out the dry pipe, cut-off flue and inside of fire-box flue sheet, turn down bead on front end, and drive flues into the boiler. Five do not give particulars. Of the whole number, three report using a hook cutter, and two report using a cutter bar to cut off flue ends. Others do not use special tools. Eleven say they take flues out through dry pipe opening, when all are to be taken out, but use one of the tube holes in front flue sheet, enlarged for the purpose, where only a few (30 or 40) flues

are to be removed. One member always takes the flues out through an enlarged hole near bottom of front flue sheet.

Question No. 2—Have you ever removed flues by aid of a locomotive or other power? If so, please give experience.

Answer—Mr. Allen Cooke, of the Chicago & Eastern Illinois, says he has removed flues with a locomotive, but does not think it pays.

Mr. Wm. Swanston, of the Chicago, St. Louis & Pittsburgh, has tried to draw flues through the front flue sheet, but without success.

Mr. Jacob Johann, of the Chicago & Atlantic, has used an engine to pull out a few flues, but gave it up for the reason that it strained the flue sheet and ground the holes out of round. A better way, he thinks, when only a few bottom flues are to be taken out, is to ream out one hole, about one-eighth of an inch, and draw the flues with a windlass of two-inch round bar iron, to extend across front end and to rest on two of the front end studs; in each end of this bar should be a 1-in. hole for ⅞-in. lever, in center of bar to be an eye bolt with chain attached; to use cut bead, etc., off both ends of flue, and drive it out 6 in., attach chain, and draw flues out with windlass.

Mr. Wm. Montgomery, of the Philadelphia & Reading, says he never used a locomotive for this purpose, but has witnessed the experiment and considers it very dangerous, on account of liability to break the bridges between holes in flue sheet.

One other member reports using a windlass, but does not describe it.

Question No. 3—Does the manner in which flues are set affect your plan of removal; if so, how?

Answer—Nine members report that the manner in which flues are set does not affect their plan of removal.

Mr. Wm. Montgomery, of the Philadelphia & Reading, says that putting copper ferrules on fire-box end gives some trouble in drawing flues through front flue sheet. He sets the flues in back end with a tool which enlarges the flue and ferrule inside the sheet.

Mr. Jacob Johann says that in using the "Prosser expander" the piece left after cutting off the end is a trifle harder to get out of the way.

Mr. R. C. Blackall, of the D. & H. Canal, reports that flues set with the "Prosser expander" are more difficult to remove than those set with the "Roller expander," on account of shoulder being formed on inside of sheet.

Question No. 4—What do you consider the most economical and thorough way of cleaning flues after they have been removed from the boiler?

Answer—Ten members report the tumbling-barrel as the best means of cleaning flues.

Mr. William Swanston reports that for the past 18 months he has been using an Otto flue cleaner, manufactured by the Flanders Machine Co., and regards it as the best appliance for the purpose he has seen.

One member scrapes his flues, but has no experience with any other method.

Mr. T. J. Hatswell, of the Flint & Pere Marquette, tumbles his flues in water.

Mr. J. S. Graham, of the Lake Shore & Michigan Southern, in speaking of tumbler used by that company, says tumbler is made of an old boiler, lengthened to suit, and is run at a speed of 30 revolutions per minute; can clean 45 to 50 flues at a time, in one to two hours. Thinks this form of tumbler especially good, as the rivet heads on inside of sheet find the poor flues by indenting or breaking through the thin spots.

Mr. Jacob Johann thinks a few hard clinkers should be put in with the flues, and the tumbler speeded just fast enough to carry the flues to the top centre, letting them drop before they pass that point; thinks that the drop does the work much more efficiently than the mere rolling of the flues over each other.

Question No. 5—What have you found to be the best manner of resetting flues?

In resetting flues, hardly any two of the members do the work exactly alike, and we give method employed by each.

Answer—Mr. R. C. Blackall says that their practice is to anneal both ends of tube, drive on swedge to take off bur, and compress ends for copper liner, expand with "Prosser tool," bead and calk, then finish lightly with Dudgeon roller.

Mr. W. Woodcock, of the N. J. C. Div., P. & R. Ry., uses the Prosser expander, and thinks it pays best, because flues are set out between sheets and form a stay; uses the Dudgeon roller to set flue out to fit sheet, also uses the latter tool for repairs.

Mr. Allen Cooke says drill hole for 2 in. flues, 2 1/16 in., use copper ferrule to bring diameter of hole down to 1⅞ in., secure ferrule in hole with Prosser expander, swedge flue ends taper for driving fit, expand hot with mandrel to fit flue holes in front end; as fast as flues are driven home, expand with Prosser expander enough to hold in place until all are in, then use expander hard enough to set flue out tight and form collar inside, so that sheet is held between collar and bead; lap flue with ball hammer and bead with heel tool, being careful to always work outward, working flue over copper, and make small bead; use Dudgeon's expander lightly to finish with. Thinks it pays to bead front ends, as flues make a better brace for sheets by doing so.

Mr. T. J. Hatswell uses copper ferrule on fire-box end; uses Dudgeon expander, and beats flue over the copper; gives no particulars as to front end.

Mr. C. W. Mills, of the Rochester & Pittsburgh, says set flues and roll with Dudgeon expander. No particulars.

Mr. John Player, of the Central Iowa, reports that the best manner that they have found is to use the copper ferrule and roll or expand with the Dudgeon expander.

Mr. Jacob Johann says he prefers to have the flue holes in back flue sheet a trifle less in diameter than flues, and after grinding the rust off the end of flues with an emery wheel to drive them into place, flue holes in front sheet to be 2 1/16 in. in diameter for 2 in. flues, to allow for light copper ferrule. He says, however, that many of the engines now on that road have flue holes in back sheet 1 5/64 in. in diameter; this necessitates swedging down the back ends of the flues, and the holes are so badly out of round that copper ferrules have to be used in order to make a joint.

Mr. J. S. Graham knows of no better way than rolling front end and rolling and beading back end; he uses a roller turned to the same taper as the spindle, but reversed, so that the large ends of the rollers shall come on the inside of sheet, when used, insuring a joint at that point first.

Mr. Wm. Swanston says the best plan they have tried for doing this work is to bore the holes in flue sheet 1/32 in. larger in diameter than the flue, swedge or die the fire-box end of flue down 1/32 in., and braze on a copper ring; this to be filed off to a driving fit in sheet; on the front end the scale is removed from flue and a light copper ring inserted (but not brazed) between sheet and flue; use the roller expander and bead fire-box end; do not consider it necessary to bead front end.

Mr. Wm. Montgomery reports that they have found the best manner of setting flues to be as follows: Swedge down fire-box end 1/32 in., file the end off bright, and put on a copper thimble to bring flue up to size, set with Dudgeon expander, then use tool to form a groove or enlargement of flue just inside sheet, making a joint next the water; bead flue on outside of sheet. This makes a firm job, and not one likely to be loosened by expansion of the flues.

Mr. George Hackney, of the Atchison, Topeka & Santa Fe, uses copper bushings expanded to fit holes in flue sheet, end of flue to be ground smooth on emery wheel, placed in a position, and expanded with roller, only fire-box end beaded.

Mr. G. W. Stevens, of the Lake Shore & Michigan Southern, expands with roller and flanges with thumb tool.

Question No. 6—What material do you consider the best for flue ends?

Answer—Nine members say that they consider good soft iron the best material for flue ends.

Two use semi-steel.

Mr. T. J. Hatswell says, use ends of the same material as the body of flues.

Mr. Montgomery says that he thinks that it will pay to put ends of good charcoal iron on new flues.

Mr. W. Swanston reports having tried flue ends of steel and semi-steel, but without much success.

Question No. 7—Have you found it more satisfactory to weld or to braze ends to flues?

Answer—Eleven members report in favor of welding ends to flues.

Mr. Jacob Johann says either welding or brazing can be made satisfactory, and he thinks there is little difference between the two methods; says he knows from actual experience that when fitted up, with special tools for cutting off, scarfling, and brazing, that the brazing can be done much cheaper than welding, and always insures a straight flue; in brazing much cheaper labor can be employed than in welding. The first cost of fitting up for brazing would be greater than for welding, but thinks that the difference in cost of doing the work would more than offset this. More flues can be brazed than welded per day, with a given number of men. A description of special tools used by him for brazing is now in possession of your Association.

Mr. W. Swanston says: We only resort to brazing when flues are of so poor a quality as to give trouble in welding.

Question No. 8—Does the character of the water or fuel used in any way govern the manner of doing the above work? If so, please state in what particulars.

Answer—Eight members report that neither water nor fuel materially affect the manner of setting flues.

Mr. Wm. Swanston thinks, with good soft water, it would not be necessary to use copper rings, and that as good results would be obtained by setting flues iron to iron, but with water of that section, copper is a decided improvement.

Mr. Jacob Johann thinks that flues tight with one kind of water and fuel will be tight with another, but thinks that they may make a decided difference in the length of time flues remain tight. Says the softer and freer from sediment the water is, and the more free from sulphur the coal is, the longer the flues will last; thinks also that the length of time that the flues will last depends materially on the engineer.

Mr. Montgomery says that they use the same engines for both hard and soft coal, and he does not see any especial difference, but that the beads on bottom flues burn off faster with hard than with soft coal. Uses, in some cases, cast-iron ferrules, which he thinks are an advantage. Does not think that the quality of water affects the method of setting.

Mr. W. Woodcock uses a "Saddlers'" patent flue welding machine. The weld is made by revolving rolls, and is a very simple and effective machine.

Mr. Allen Cooke sends sketch of crimping tool, which find attached.

Mr. T. J. Hatswell sends blue print of "Hawks Bill" for cutting off flues, which please find attached, he also gives price of taking out welding and resetting one flue by hand at 17 cents.

From the reports furnished, and from our own experience, we have reached the following conclusions:

First—The best known method of removing flues is to use a cutter bar, to cut off flues inside of front flue sheet, and turn down bead on back end; when all flues are to be taken out, take out dry pipe and take out through dry pipe opening; when only a few flues are to be removed, use one of the tube holes in front of flue sheet, enlarged for the purpose.

Second—Taking all of the circumstances of the case into consideration, do not consider it advantageous or economical to use locomotive or windlass to remove flues.

Third—The manner in which flues are set does somewhat affect the plan of removal, but in consideration of the great importance of having flues set to give the most efficient service in practice, do not think the difference enough to be considered a factor.

Fourth—Consider the tumbling barrel as the best known means of cleaning flues.

Fifth—Know of no better method than rolling front end and rolling and beading back end; use copper ferrule expanded to fit holes in flue. Flue to be placed in position and expanded with roller; do not consider it necessary to bead front end.

Sixth—Consider good soft iron the best for flue ends.

Seventh—Have had no trouble from either brazed or welded flues; with proper flue welder, have every reason to believe welding is cheaper.

Eighth—Would recommend manner of setting as explained above for all kinds of water or fuel.

Your committee have not received or prepared drawings of flue welders or other special tools, but feel assured it would prove of great advantage to have such gotten up, and that the above subject deserves further investigation by the members of this association.

Respectfully, CLEM. HACKNEY,
Chairman.

Mr. Clem. Hackney asked Mr. Johann why he thought brazing was cheaper then welding flues?

Mr. Johann had no exact figures ready, because the question was not expected. When he was on the Wabash they brazed the flues at Springfield and welded them at Fort Wayne and Moberly. Had special machinery for both operations. He ordered tests to ascertain the relative cost of the operations. Took 300 flues at each shop. They were cleaned, trimmed and brazed or welded, as was the practice of each place. The records showed that for welding the cost was from $24 to $28, and for brazing from $16 to $17.

Mr. Campbell moved to continue this committee for another year. Carried.

Mr. Blackwell said the committee did not appear to have got information about a most useful cutter used inside of flue with action similar to the pipe cutter. When he was on the Norfolk & Western his foreman got out a cutter of this kind and it worked admirably. It saved the work of putting the flue in lathe for cleaning up ends. Was not aware that the device was patented.

Mr. Meehan did not think it mattered much how tubes were cut. Thought the method of cleaning was more important. Did not favor the milling apparatus used for this purpose, as it failed to take the carbon out of the inside of the flue. By tests he found the carbon scale acted prejudicially on steam-making. He stood out for the rattler.

Mr. Setchel wanted to know if it is necessary to bead flues in front end. He knew that a great many roads did so, but the Committee say in their report that it is not necessary. He wished to test the sense of the convention on the matter. For thirteen or fourteen years he had been in the habit of just rolling the flue in the front end and letting it stick through the sheet about ¼ of an inch. If that can be done universally it is quite a saving of expense.

Mr. Campbell had followed the same practice for several years and found it satisfactory.

Mr. Setchel moved that it is the sense of this convention that it is unnecessary to bead flues in the front end.

Mr. Lauder thought some of the younger members might conclude that if beading was unnecessary in the front end, it was not needed in the back end. They would be mistaken in such a conclusion, for the mechanical action of the sparks would cut the ends of the flues and the flue sheet unless they were protected by beading over.

Mr. Johann did not think there was any necessity for the association going on record on this matter. If the resolution were passed every one would go home and continue the practice that suited him best.

Mr. Setchel explained that the object of his motion was to get the sense of the convention on the matter. He had been years learning that beading the front end of flues was no advantage, and was aware that several important roads did not follow the practice. If any members who were following the practice wished to save the expense it entailed, they would be encouraged to make the change on hearing other members express their views in favor of abandoning the practice. He thought a saving of five, ten or fifteen dollars an engine was worth looking after.

Mr. Briggs had experienced trouble with the flue sheet bulging out when he did not bead the front end of the flues. He had run a bolt from one end to the other to draw the sheet back, and had finally concluded it was better to bead the front ends and allow the flues to act as stays. In a large boiler there was a great area subjected to pressure, and he did not know what was going to hold the flue sheet if no beading were done. Rolling with an expander would make the flue hold to some extent, but he preferred beading part of them.

Mr. Griggs urged members to vote according to their convictions, and to show that they were not ashamed of their opinions.

Mr. Allen Cooke was in favor of beading the front end of flues, and he considered the practice prevented the flue sheet from bulging. With the high pressures coming into vogue he thought they required still more staying.

Mr. Johann protested that he was fully in favor of discussing this matter, but did not think it was necessary or desirable to vote upon it.

Mr. Briggs said the opinions of this association are considered as authority for the guidance of others in mechanical practice. He urged the members to have the courage of their convictions and come to decisions on improvements they favored. He wanted to get the association to give its authority as to the best way of beading flues. Their decision would tend to educate others as to the best plan for putting in flues. It appeared to him that common sense taught that beading flues at both ends was a necessity, but he was willing to hear other men's opinions. Opinions were not laws.

Mr. McCrum's experience with this matter had been similar to that of Messrs. Briggs and Cooke. When boilers were small he had set a great many flues by expanding them in front only. With larger boilers he experienced trouble with the back sheet bulging and the flues pulling through the sheet. On account of that he adopted the practice of beading flues at both ends. It may not be necessary to bead the flues around the outside, but while beading the majority he thought it was as well to bead them all.

Mr. Black had been in the habit once of beading the flues, but of recent years he had adopted the practice of beading the flue sheets inward, which stiffens them so much that no stays or their equivalent of beaded flues is necessary.

Mr. Lauder did not think the reputed necessity for beading flues of large boilers rather than small ones was attributed to the right cause. He attributed the difficulty to defective circulation of water. The back sheet gets hot from this cause and bulges out. He thought the character of the feed-water had a good deal to do with the necessity for beading flues at both ends.

Mr. Briggs said that a Dudgeon expander formed the tube so that it had virtually part of a bead on each side of the sheet.

Mr. Lauder said that any modern tool used for setting flues would make something of a bead. He preferred rollers to expander.

Mr. Ackley was where they used very bad water and had very large boilers, yet they merely rolled the flues and never had any trouble with sheets bulging.

Mr. Stevens: Our practice has been to bead the flues at both ends for the simple reason set forth by Mr. Briggs and others—strengthening the boiler.

Mr. Miles did not think flues set cold would act much in the way of stays on a boiler expanded by heat.

Mr. Mackenzie mentioned that some years ago on the Union Pacific they had been badly troubled with flues bleaking at the front end of the boiler. Their practice was to roll the front of the flues and bead the back ends. They tried two engines that came out of the shop at the same time and went on the same kind of service. One had all the flues beaded at both ends, the other had the front ends rolled. The engine with all the flues beaded gave no trouble with leakage, while the other leaked from the start.

Mr. Collier was in the habit of beading the flues at both ends and liked the plan.

After some more desultory discussion the motion was put to the meeting and carried.

REPORT ON THE HAMMER BLOW OF LOCOMOTIVE DRIVERS.

To the American Railway Mechanics Association:

Your committee appointed at last annual meeting to consider and confer with a similar committee of the Franklin Institute, of Philadelphia, Pa., looking to the weighing of hammer blow or variation of pressure of locomotive driving-wheels on the rails of a railway, would respectfully report as follows, viz.:

That it was originally intended that a test of this subject would be made at the "Novelties" exhibition held in Philadelphia, during the month of September, 1885. It was, however, found to be impractical to make such test at that time. Your committee, however, met with Franklin Institute committee, September 24, 1885, as a joint committee to consider the subject. Mr. Thomas Shaw, M. E., of Franklin Institute, was chosen as chairman of the joint committee, and Mr. F. W. Dean, of Master Mechanics' Association, was chosen as secretary of the joint committee. At request of Mr. Charles Blackwell, he was relieved from service on your committee, and Mr. Coleman Sellers was appointed to serve in his place. The joint committee consisted of the following: For the Franklin Institute—Thos. Shaw, M. E., Prof. S. W. Robinson, P. H. Dudley, M. E., Theo. N. Ely, Edward Longsbroth. For the American Railway Mechanics' Association—Wm. Woodcock, Coleman Sellers, T. L. Chapman, Angus Sinclair, F. W. Dean.

A number of meetings were held and the subject fully and thoroughly discussed, and your committee would present for the consideration of the association the annexed report of the joint committee, which is accompanied with drawing and description of the proposed apparatus for making practical test of this subject.

WM. WOODCOCK, Chairman,
F. W. DEAN,
ANGUS SINCLAIR,
Committee.

REPORT OF THE JOINT COMMITTEE.

Members of the joint committee for the Franklin Institute: Prof. S. W. Robinson, Columbus, O.; Edward Longsbreth, M. E., Philadelphia, Pa.; T. N. Ely, M. M., Altoona, Pa.; P. H. Dudley, M. E., New York; T. Shaw, M. E., chairman, Philadelphia, Pa.

For the American Railway Master Mechanics' Association: Wm. Woodcock, M. M., Elizabeth, N. J.; Coleman Sellers, M. E., Philadelphia, Pa.; Angus Sinclair, M. E., Chicago, Ill.; T. L. Chapman, M. M., Richmond, Va.; F. W. Dean, M. E., Cambridgeport, Mass., secretary.

We respectfully report that your committee has held meetings from time to time, extending over a period of eight months, and have written to and kept posted any absent members of our committee, in order that all the members of said committee could have a correct understanding of our work and give written suggestions where their presence was impracticable.

Our committee being composed of professional men, on active duty in different portions of the United States, it was possible to assemble only one-half of its members at any one time.

The work of our committee, though of a seeming simple character, was in a measure problematic, and in a direction that has occasioned much diversity of opinion amongst leading engineers and scientists, many of whom contend that there is no wave force, or so-called hammer blow, from imperfect balancing, etc., and some of our master mechanics maintain that their locomotive driving-wheels are in perfect balance, etc.

It is, however, self-evident upon careful observation, that to balance any vibrating weight moving in a horizontal plane, by counter weight in the crank wheel moving in a vertical plane of rotation, that wherever the balance is made perfect in the horizontal direction, it is out of balance in the crank wheel in a vertical direction equal to a large portion of the counter weight employed to correct the horizontal movement. In view of this fact we find that engines considered most perfectly balanded by counter weights in the crank wheel, do occasion great disturbance in a vertical direction (causing a wave force that may be compared to a hammer blow), that has a measure of destructiveness upon rails and bridges dependent on weight and velocity of moving parts, and that it is worthy of the most careful examination and test. The forces induced on both sides of the engine from this cause are of a complex character, varying greatly under modifying conditions that occur in practice, that does not submit readily to calculation.

We deem a test of this peculiar action of such importance that we recommend that it be subjected to accurate measurement by means of a special dynamometer that your committee has specially devised, and which we believe is competent for the purpose.

We believe also that it will give a correct showing of the complicated and destructive force complained of, and show its exact value, which test may be regarded as causing the application of such remedies as may hereafter be provided to correct any evident damage in the direction referred to.

A description of the proposed dynamemeter is hereto annexed, the cost of which, erected in place exclusive of ground but covered by a frame building, is estimated to be $6,000. Your committee having performed their services gratuitously are not expected, of course, to provide the ways and means to procure the proposed test apparatus.

It has been suggested, however, that since the advantage of any test would be with the railroad companies, that possibly these companies would unite in providing the needful apparatus, and that in case it was provided as described, the Franklin Institute might be intrusted with the charge and possible ownership of the same for the use of all railroad companies.

The above estimate includes the expense of Prof. P. H. Dudley's recording apparatus.

THOS. SHAW, M. E., Chairman,
F. W. DEAN, Secretary.
May 31, 1886. Joint Committee.

Mr. Sinclair, as a member of this committee, strongly objected to the report of the sub-committee. He believed they exaggerated the effect of unbalanced weight in locomotive drivers. Did not think it advisable to ask railroad companies to subscribe money to defray the expense of tests.

REPORT OF COMMITTEE ON SHOP TOOLS AND MACHINERY.

To the American Railway Master Mechanics' Association:

Your Committee on Shop Tools and Machinery beg to herewith submit the following report. By dealing with but one subject the committee hoped to gather more valuable and accurate information than would likely be obtained if an attempt were made to cover a larger and wider field. They accordingly caused to be issued for distribution the following circular:

"Please state if you have used milling machines instead of planers for surfacing work. State kind of work surfaced, and difference of time in favor of either machine.

"It is not necessary to give the number of hours occupied by a machine in performing a certain amount of work, the result, if given in form of a percentage in favor of one or the other machine, will answer quite as well, the object being simply to ascertain which is the cheaper method, and to what extent."

Replies to this circular were received from ten members, five of whom reported more or less experience with milling machinery.

Mr. J. Davis Barnett believes that the value of milling begins and ends with small surfaces; that when large surfaces are to be dealt with, the expense of keeping up cutters runs away with all the profit.

Mr. Jacob Johann considers the milling machine as the equivalent of half a dozen special machines, and is decidedly in favor of special machinery.

Mr. A. M. White thinks there is a gain of ten to twenty per cent. in favor of milling, where the work is of such shape that the cutters can work freely.

Mr. H. N. Sprague has milled rod boxes successfully for several years at a much less cost than planing, but is of the opinion that the great cost of cutters for other work neutralizes what advantage the milling machine may have over the planer.

Another member writes that in the establishment with which he is connected milling is almost the only method used for finishing the strap fits of rod boxes. The bottom, sides and ends of flanges are surfaced at one cut, as accurate'y as can be done by an expert on a planer, and at about half the cost for labor; the same help having been transferred from the planer to the milling machine.

He considers the milling machine as possessing advantages over the planer for surfacing many kinds of both large and small work. When cutters of any considerable size are to be used he thinks they should be made with inserted and adjustable teeth; that is, the teeth should be held in an iron or steel head, as this admits of easily replacing them when they become broken or badly worn.

To those who believe that only small work can be advantageously surfaced by the milling process, he refers to the huge milling machines known as the rotary planer, so successfully used by bridge and roof builders for finishing ends of chords, posts and other members of structural work. Here is milling on a large scale. A cast or wrought iron head in which are held many cutters similar to those of the lathe and planer, simple, cheap and effective, a machine capable of surfacing work 48 inches in width, and of indefinite length, with such rapidity and accuracy that the planer ceases to be a competitor, and he thinks it fair to assume that a similar machine would back off cylinders as quickly and as accurately as it does the work upon which it is commonly engaged.

This member is also of the opinion that the common idea that large milling tools are too expensive to be of practical value is not well founded. Large milling cutters, if fitted with inserted teeth, are not more expensive to keep up than a given number of lathe and planer tools of similar dimensions.

If, however, large cutters have to be made from the solid, thus giving the tool dresser an opportunity to undo the machinists' labor of days and perhaps weeks, we are dealing with unsafe methods rather than with wrong principles; with such cutters the rotary planer would surely become a complete failure as a labor saver; therefore, they who attempt to do any considerable amount of milling with large solid cutters are not likely to become converts to this method of surfacing work. But with the well-designed milling machine and properly constructed cutters, he believes the question of milling and planing will in very many cases be decided in favor of the former machine.

D. A. WIGHTMAN,
A. J. PITKIN, } Committee.
F. B. MILES,

NEW HONORARY MEMBERS.

On motion of Mr. Johann, Messrs. P. I. Perrin, C. J. Parry, E. H. Williams and H. J. Brooks were elected honorary members.

STEAM ENGINEERING.

Mr. Coleman, associate member, delivered an address on steam engineering. The chief point of Mr. Coleman's address was the necessity for heating the air supplied to the fire, of maintaining the highest possible temperature in the furnace, and of preventing anything which will lead to reduction of the temperature. He referred to the gradual development of the boiler, and, coming to the locomotive boiler, he doubted whether the increase in heating service and size of fire-box had kept pace with the increase in weight of the locomotive. He referred to some experiments he had made with a Wootten engine for the Italian Government in the burning of coal-dust and lignite, the result being a great success. He believed that the success of the Wootten fire-box, there and elsewhere, was due to the large grate surface, and the use of a thin fire, insuring rapid and complete combustion and a high temperature in the furnace. He believed that the true development of the locomotive could be defined in two simple expressions—more complete combustion of coal, and the compound locomotive utilizing the full pressure of steam.

SUBJECTS FOR NEXT CONVENTION.

The Committee on Subjects presented its report, recommending the following questions for discussion at the next annual meeting:

1. To Give Best Results, What Rule Should be Followed for Proportioning the Cylinders of an Engine, when Size of Driving-Wheels, Weight Available for Adhesion and Boiler Steam Pressure are given quantities.
2. Traction Increasers, their various types and relative merits; also cases in which their use can be recommended.
3. Cross-heads and Guide-bars; various types in use; materials used in their construction and results obtained.
4. Packing—various forms of piston packing in use, and results obtained, also most economical and satisfactory packing for piston rod, valve-stem, regulator and air pump stuffing boxes.
5. Washing out and Lighting up Engines; best systems in use for washing out, and most economical and expeditious mode of raising steam, and necessary plant for same.
6. Coaling up engines; the various plans in use, their relative cost and efficiency.
7. Standard form of tire section.

The report was received.

Two additional subjects were suggested—Lubricants, and (8) The Influence of the Man at the Throttle on the Wear of Driving Wheel Tires. The last named was made the eighth subject.

NEXT PLACE OF MEETING.

After some discussion, Minneapolis or St. Paul was chosen as the next place of meeting, the decision between the two cities to rest with the executive committee.

OFFICERS FOR THE ENSUING YEAR.

The following officers were elected by ballot: President' Wm. Woodcock, Elizabethport, N. J.; First Vice-President, Jacob Johann, Huntington, Ind.; Second Vice-President, R. H. Briggs, Elizabethtown, Ky.; Secretary, J. H. Setchel, Dunkirk, N. Y.; Treasurer, George Richards Boston.

The election was made unanimous by a rising vote, and all the officers were called upon for speeches, which were given.

After some routine business, the convention adjourned to meet at the place selected on the third Tuesday in June, 1887.

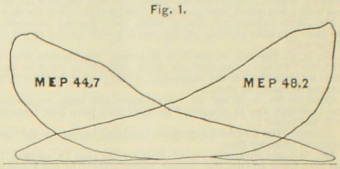
Evils of Throttling Locomotives.

So much has been said and written of late about the economical advantage of using steam expansively, that recurring to the subject might appear a gratuitous waste of words; yet so much heat has been thrown away hourly on the majority of locomotives running on the American continent through the steam not being expanded in the cylinders as far as the construction of the engine admits, that we feel justified in returning to the subject. If we can stir up those who are responsible for the waste of heat to a realizing sense of their duty, a good work will be accomplished.

The tendency of American railway mechanical engineers and locomotive designers has been for years towards higher boiler pressure, the reason given for this movement being that high boiler pressure permits of a higher average cylinder pressure with consequent greater duty out of a given volume of steam. The theory in this matter is perfectly sound, but the practice of locomotive operating has rendered an excellent theory fruitless of good works. What is the use of carrying 180 pounds of steam or a like pressure on a boiler, if it is to be habitually reduced 40 per cent. before reaching the pistons? Complaints are constantly reiterated that the link motion and plain slide valve render the efforts of high steam advocates futile, since they do not admit and release the steam so promptly as these operations are performed in automatic engines. But what is the use in trying to design an improved valve motion for locomotives when that in use is seldom permitted to do its best through the steam being throttled down? The engineer who is laboring to improve the locomotive is following out a highly laudable and praiseworthy purpose, but trying to get the best possible service out of the existing engine is likely to be productive of greater dividends than scheming new designs. Two leading reforms are necessary with the locomotive we use before radical improvements are called for. The coal ought to be burned so that it will impart the greatest possible amount of heat to the boiler, and the steam should be admitted to the cylinders as near as possible to boiler pressure. Many roads are working hard to improve the methods of firing, and great reforms have been effected in this respect during the last year or two, but little is being done to change the prevailing practice of running with a partly opened throttle.

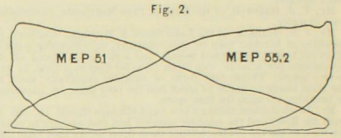
The men who run locomotives are not to blame for the existing habit of using the steam throttled. When an engineer can run his engine in any notch with the throttle wide open, it is generally done, but the notches on the short cut-offs are too wide apart, and throttling is resorted to because the steam cannot be regulated by the link. The experience of roads that use steam reverse gear ought to indicate that an improved method of regulating the cut-off would pay well. It has been proved where engines of the same class are doing the same work, that those equipped with the steam reverse show a saving of from 5 to 10 per cent. over those having the ordinary notched quadrant and reverse lever. Some engineers having a desire to make a good record, are in the habit of using a block which enables them to move the reverse lever half a notch, but this is a most unmechanical way of holding the lever, and master mechanics ought to provide something

Fig. 1.



Steam, 130 lbs. Cut-off, 6 inches. Speed, 156 revolutions.

Fig. 2.



Steam, 130 lbs. Cut-off, 10 inches. Speed, 156 revolutions.

better. There appears to be a curious prejudice in the United States against using a screw reverse, yet the screw has many advantages over a notched quadrant and lever.

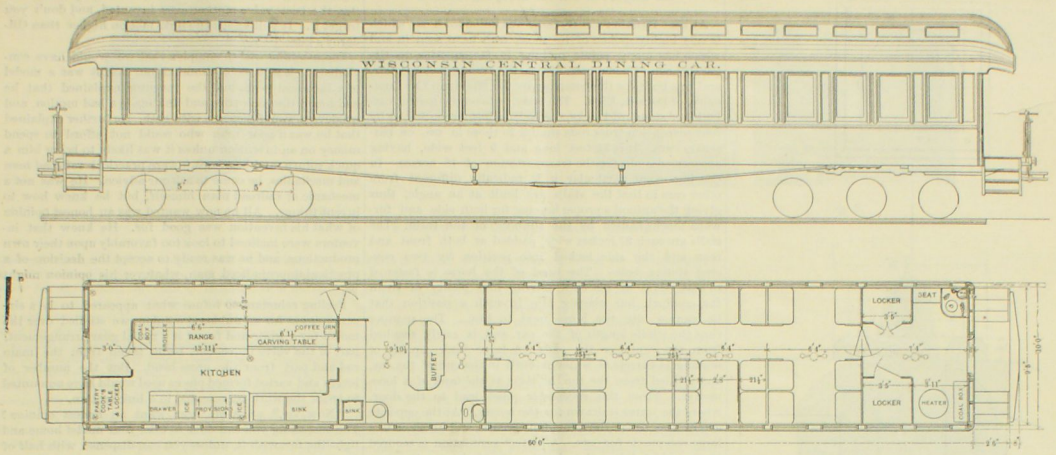
The annexed diagrams, taken from a locomotive pulling a heavy passenger train, illustrate the difference in steam used per horse-power when the steam is admitted freely to the cylinders, and when its velocity is reduced by throttling. Both cards were taken at the same speed—156 revolutions per minute—which was close on 40 miles an hour, and with the same boiler pressure. The diagrams in Fig. 1 were taken with the throttle wide open, the reverse lever being in the 6-inch notch; the diagrams in Fig. 2 were taken with the lever in the 10-inch notch and the steam partly throttled. The two cards on Fig. 1 show a mean initial pressure of 112 pounds; those on Fig. 2 show 91 pounds initial pressure. The unthrottled diagrams indicate 200 horse-power for one cylinder produced at a steam expenditure of 18 pounds per horse-power; the throttled diagrams indicate 227 horse-power for one cylinder, 22.5 pounds of steam being used per horse-power. In the larger diagram more work is represented than in the small one, but it is done by using 25 per cent. more steam per horse-power. Had the engine been linked up and the steam admitted at full pressure with an open throttle, there is no reason to doubt that the heavier work would have been performed as economically as the lighter.

A more liberal use of the indicator would supply our railroad men with much useful information about their engines. But when the indicator is used, the diagrams should be taken just as the engineer works his engine. The common practice of directing the engineer to open the throttle wide every time a card is to be taken, suppresses the information all concerned are most interested in obtaining.

Fast Runs.

A train consisting of an engine, baggage car and one coach, recently ran 96 miles on the Baltimore & Ohio road in 2 hours and 7 minutes. The section traversed has three 90 feet grades, and seven minutes were lost on a bad piece of road. The engine was one of four new ones built at the Mt. Clare shops. They have 56-in. boilers, 230 flues, cylinders 18 × 24 in. and 69 in. drivers. Weight of engine 50 tons. The run was made to carry some missing baggage from Benwood to Grafton.

Another fast run was made not long ago on the Wabash, St. Louis & Pacific, between Kansas City, Mo., and Wabash, Ind. The distance is 563 miles, and was made in 13¼ hours, at the rate of 40.95 miles per hour, without allowing for stoppages. The train was a special; weight not stated. The run was made with one engine.



DINING CAR—WISCONSIN CENTRAL RAILROAD.

The engravings represent a side elevation and plan of a very handsome style of dining car, which is being constructed for the Wisconsin Central Railroad Company. Cars of this kind will be used for the entire dining service of the road. It will be seen from an inspection of the plan, that the arrangement is made so that two persons may sit abreast at the tables on one side of the aisle, while the tables at the other side have room for one at each end. By this means twenty-four persons can dine in the car at once without the least discomfort from crowding. The car throughout is very spacious, the leading dimensions being length 60 feet, width 10 feet over sills, and the height from top of sill to under plate, 6 feet 8½ inches. The inside finish is quartered oak, except the kitchen, which is black walnut. The ceiling is of birch with a neat decorative design, and the floors are of selected maple throughout. The car is carried on the Wisconsin Central standard 6-wheel truck, with 33-inch Allen paper wheels. The entire equipment of these cars is first-class in every particular, and no trouble or expense has been spared in making each car a model of its kind.

Norway Pine and the Car Sill Trade.

Of late years the demand for Norway car sills has become a prominent feature of the mill business in the interior of Michigan, and particularly with the mills scattered along the lines of railroad. But this demand fluctuates with the conditions of the times and the varying prosperity of the railroads. With the decline of construction which began in 1883, there came a falling off in the car sill requirement. Rolling stock building fell to a minimum, so that the call for car sills was slow and scattering. But with the measure of revival in railway matters that began to be manifest early last fall, came increased inquiry for car sills. At first it was fitful and cautious. Mill operators, that occasionally got a nibble of an order, sold the stuff cheap, and dared not indulge much confidence in the outlook. At first they were willing to contract heavily at $7.75 a thousand. In October or November they would have been glad to contract all they could have sawed for months at $8.50 to $8.75 a thousand. In December an entire mill cut at Cadillac could have been obtained at $10.50 at the mill, and could have been delivered in this city at $13 to $13.50 a thousand. Two or three months later dealers were mentally clubbing themselves because they did not close bargains at those figures, for prices went up to $13 at the mill and $16 delivered in this city or contiguous points. In fact, before navigation opened in the spring, orders were placed in Chicago at $19 a thousand. Norway car sills are worth to-day, delivered here, $16 a thousand. During the season of navigation prices are modified and kept steady by reason of low lake freight rates.

It is a matter worth inquiring about to know why car sills can sell delivered at $16 a thousand, while Norway short, heavy timbers, up to 12 × 12 inches in diameter, have to beg for $10.50 a thousand. The answer is, simply because car sills can never be kept in stock, or put on the open market; they have to be sawed to specification. And specification in the matter of car sills is of great variety, though all are on a basis of 4½ × 8½ to 6 × 8 inches in cross section, but they vary in fractions of an inch, or possibly an entire inch in isolated cases, above the initial dimension. No mill operator can saw and pile up car sills and wait for a buyer. No buyer for a car manufactory can contract ahead of the work actually in shop. Each order for cars is accompanied by specifications as to the size of the sills. When these are ascertained, the order is sent to the mill. If a car works were morally certain of having a contract to build a million cars, not an order for a car sill could be given until the specifications had been received by the master builder, not even if lumber were on the jump upward in price three points at a jump.

Hence we have the remarkable phase of the car sill trade that has been witnessed within the past nine months. Last August nobody knew anything about car sills beyond the fact that there was no call for them. In September there was a whiff of demand; in October, a gentle breeze; in November, a fair wind, and after January 1, a stiff gale. Since the opening of navigation and the strikes in May, the demand has slowed down a little, but it is now by no means dead, or dealers would not be able to get $16 a thousand for them, while other forms of stock dimension can be had by the cargo, and much of it just as good timber, for $9 to $10 a thousand.

Now, why did the car builders have to give $17 to $19 a thousand for car sills in February and March last, when the mills would have been glad to have sawed them by the million in August before for $7.50, and delivered them for $10 a thousand? Simply because the car builders, though they anticipated a demand for cars, could not place orders for sills until orders and and specifications for cars were in their hands.

The competition between Norway and Southern pine car sills is a matter of some interest. In the item of strength the yellow pine has the lead. But, as a dealer in this city remarked, mere superiority of strength does not always win. A car sill need not necessarily outlast the other portions of the car. In a smash up a yellow pine sill would break as well as a Norway sill. Cost has something to do in determining the purchase of sills. Yellow pine may make a superior support to a car, but where Norway is good enough, and about $8 a thousand cheaper, that settles it with many builders and buyers.—*Northwestern Lumberman.*

Diverse Experience with Extension Smoke-Boxes.

The extension smoke-box was tried by Mr. J. L. Corey, Master Mechanic of the Delaware & Hudson Canal Company, on some locomotives under his charge, but gave such bad results as a spark arrester that the engines were changed to the old form. We have heard of many cases where the extension front worked badly till its parts were properly adjusted.

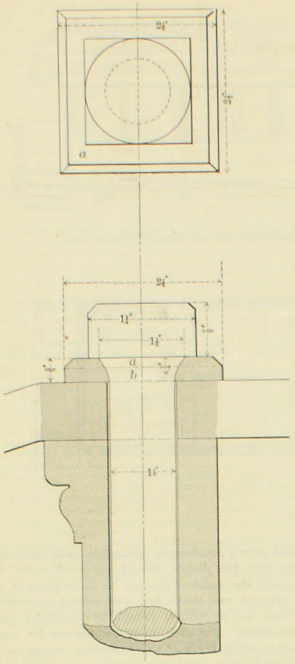
There is something curious about the difficulties that sometimes arise in making extension smoke-boxes do their work properly. We lately heard of a case where a master mechanic determined to apply the extension front to some of his engines. He got detail drawings from a neighboring road where the device was in use and doing well, but when the engines were put upon the road they did not steam so well as they did with the diamond stack. Considerable changing and adjusting of parts had to be done before the engines were made to work properly, but they were made to steam more freely than they did before the change was made, and the extension smoke-box was admitted to be much superior to the diamond stack as a spark arrester.

Several other master mechanics have told us that their experience was in many respects similar to the case mentioned. On the other hand, a master mechanic noted as a conservative man, but excellent mechanical engineer, told us he had never taken any stock in the extension smoke-box, and gave a great many plausible and philosophical reasons why the device should not work well. He insisted that the smoke-box had to be emptied of gas by every exhaust, and that a box with a large cubical capacity could not be cleared except by increased speed of exhaust steam. For that and other reasons he regarded the sentiment in favor of the extension smoke-box as a pernicious fallacy. But his general manager got touched with the malady and yearned to see one of the locomotives equipped in the latest fashion. As becometh a wise man, the master mechanic suppressed his own convictions and prepared to change an engine in accord with the general manager's desire. He used the outlines of an extension front illustrated in the NATIONAL CAR AND LOCOMOTIVE BUILDER, and designed details for himself. The engine went into service without any experimenting to find the proper adjustment of parts and worked admirably. The enginemen on the road all abuse the extension front, as seems natural to men who are familiar with the master mechanic's sentiments; but there is no gainsaying the fact that the engine steams more freely than she did before, is a better spark arrester than the other engines, and does the same work with a slight saving of coal. These are the semi-facetious confessions of a bright master mechanic who seemed loath to believe that there was not an unaccountable mistake somewhere.

Railroading in Mexico.

The Springfield (Mass.) *Republican* says: The expenses of railroading in Mexico are great. Wooden ties have but a short life, cracking in the dry season and rotting during the rainy months; bridge timber and piles also wear out rapidly. Freight cars must be painted frequently to prevent drying and cracking, and even the substantial Pullman cars shrivel under this exposure. Fuel constitutes a large item of outlay. Mesquit roots are burned on the Central road; pine, cut along its route, is used on the Interoceanic, and the Vera Cruz Company feed their engines coal blocks that are brought from Wales as ballast. The decay of ties will in time necessitate a serious outlay on the Central road, for wooden sleepers cost here $1 each. It is evident that iron ties are a necessity in Mexico, and they are just coming into use. The climate tends to preserve the rails and iron bridges, provided the latter escape the torrents of the rainy season. Engineers command better wages here than they do in the United States, for only that inducement brings them here. The general staffs of the roads are also well paid, but the section hands, who are peons, work for small wages. The natural and proper tendency on all the roads is to employ Mexicans when the right men can be obtained. This policy helps to protect the property of outside corporations doing business here.

IN the account of the New York State car coupler trial in our last issue, we omitted to say that the Boston Automatic Coupler, which successfully stood the four prescribed tests at East Albany, had also passed the tests at Buffalo, and on June 14, 1886, was prescribed by the Massachusetts commissioner for the railroads in that State. It is of the vertical plane type, has a double-slotted head, with a back resistance which prevents links from passing head and catching the hands of brakeman, is box bearing with an adjustable hook lever attachment, has no springs, is self-acting, couples readily with one or both heads open, or can be set not to couple. Is composed of only three parts, stem, head and gravity lever, and each part occupies its proper place as it comes from the foundry, without requiring any machine work or fitting to make it operate.



Improvement in Arch-Bar Column Bolts.

The above engraving is from a drawing sent us by Mr John Kirby, the general master car-builder of the Lake Shore & Michigan Southern road, and represents an improvement in the construction of freight car trucks. Experience has shown that in the diamond truck the posts or column bolts between the upper and lower arch-bars are the first to give way. A portion of the upper bar ($1\frac{1}{4} \times 3\frac{1}{2}$ inches), the top portion of the cast-iron column, and also the washer, are shown in the cut.

The improvement consists in making a fillet *a* under the head of the bolt, which greatly increases its strength, without any material increase of weight. The square washer *b* is made of iron $\frac{5}{8}$ in. thick and $2\frac{1}{2}$ in. wide. The hole is punched, the countersink is made to exactly fit the fillet, and the corners of the washer are hammered down at the same blow. It is better to make the countersink in this way than to trust the men at the drill. It will readily be seen that the fillet not only increases the diameter of the bolt under the head, but also prevents cold sheet or mitering of the iron caused by the upsetting process by which the head is made.

An Improved Car for Carrying Horses.

At East Buffalo recently there was unloaded a car which is very highly spoken of by those who have seen it, and which has many points making it far superior to the general run of horse cars. It is the Wicke's horse car, and was built for the company by the Michigan Car Company, of Detroit, Mich. The body rests on the master car-builders' standard trucks, the body being strengthened by four suspension truss rods similar to those in use on passenger cars. It is 54 feet long and 9 feet wide, having accommodations for the transportation of 18 horses. In one important particular it is radically different from other cars in that the stalls are built at an angle, thus giving the animal a proper bracing for both side and forward shocks caused by the running of the train. The stalls are each 27 inches wide, padded at both front and rear and the side locked into position by two covered sliding bolts. The head of the horse is fastened to both sides of his stall, giving him plenty of room for comfort, but placing him in such a position that he cannot bite the horse next to him. The manger runs the whole length of the car, and is easily reached from the center or the ends. A large tank capable of holding 14 barrels of water is built in the end of the car, and is filled from the top the same as the tank of a locomotive. From this receptable pipes lead to the door, where the water is drawn for the horses. At the opposite end of the car is the attendant's bunk, and under it is a large receptacle for oats. A perfect ventilation is secured by the aid of sliding slats in the side of the car, the openings in all cases being guarded by fine wire screens set at an angle in such a way as to catch the air, no matter in what direction the wind blows. The center door has a glass window which may be removed, leaving a screen as a protection. In case of cold weather or illness among the horses, ventilators in the clear story, similar to those in use on passenger cars and on which a patent has been secured by Mr. Wicke, may be used. In order to facilitate cleaning the car, a double floor is built at the horses' fore feet, the lower sloping slightly to the side of the car, where a small trap allows the washing of the floor. The car has met with great favor from those who have seen it, and it will undoubtedly prove very popular among horsemen and dealers.—*Buffalo Express.*

An Inventor's Thanks for Advice.

A man walked into our office one morning with an article under his arm bundled up in a sere copy of *Peck's Sun*. He was lank and cadaverous in appearance, with more limb than he seemed capable of controlling properly, while his clothes, which were not of imposing texture, looked as if they had been thrown on at random. Walking in with the utmost freedom, he cordially grasped our hand and expressed the liveliest satisfaction at making our acquaintance, even though his approaches were coolly received. On finding that his impression that we represented the CAR AND LOCOMOTIVE BUILDER was correct, he began unwrapping the article he carried. We mildly requested him to desist, saying we did not wish to examine any new patent car couplers that week. "Wrong again," he chuckled, "I have got something better than a car coupler," and he brought to view a wooden apparatus evidently formed with a chopping axe and finished with a jack-knife. "This," he continued, holding up the model, "is the best valve motion ever invented, and don't you forget it. It will knock the link motion higher than Gilderoy's kite."

The machine was so complex that we would have concluded, on a superficial examination, that it was a model of a Jacquard loom, but the inventor explained that he had heard the eccentrics and link made a bad motion, and his device would dispense with both. He further explained that he was a poor man who could not afford to spend money on an invention unless it was likely to bring him a quick return, and hearing we were practical railroad men and mechanics, he came to ask our advice. He was not a mechanic or railroad man himself, but he knew how to invent things. All he now wanted was an honest opinion of what his invention was good for. He knew that inventors were inclined to look too favorably upon their own productions, and he was ready to accept the decision of a practical unprejudiced man, whatever his opinion might be.

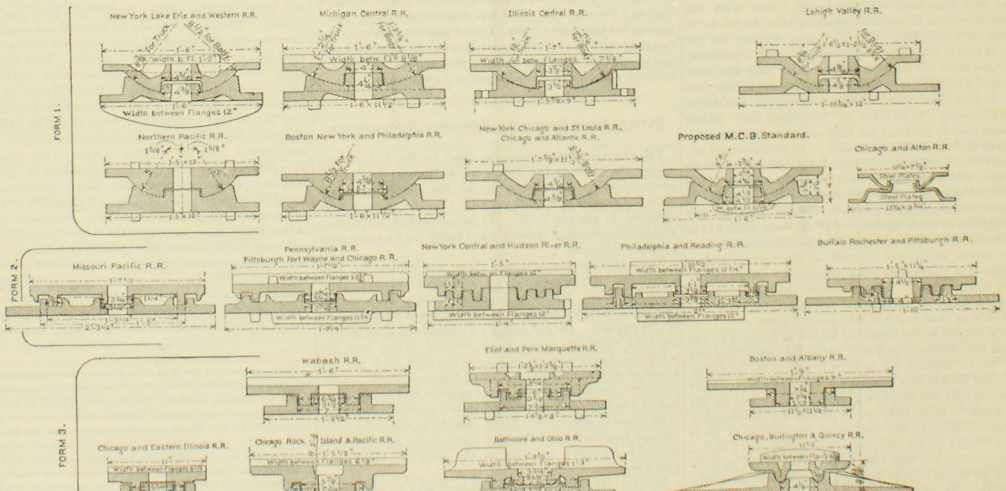
Feeling reluctant to refuse what appeared to be a sincere request for an unbiased opinion, we studied over the model for a while and found it a radial gear arrangement, part of the valve movement being taken from the main rod and part from the cross-head. But the number of levers and varied formed pieces used would have amounted to twice the work represented in a link motion.

"Now, sir," we said, "you want an honest opinion? The best thing you can do is to take your model home and light the fire with it, unless you can dispense with half of the levers and pieces used."

The man, who so humbly solicited honest advice, then jumped up and swore a streak of oaths, amidst which we got the assurance that he never yet met with a railroad man who knew anything, and that newspaper men knew still less. Nothing would give him more satisfaction than to clean out the whole shebang. He would do it, too, if any one would offer him two cents for the job. Our long-suffering patience being then exhausted, in words that were not meek we prevailed on the inventor to depart lest something might happen to accelerate his progress down stairs. We are not in the business of giving advice to inventors any more.

TRIAL tests were recently made on the Connecticut River R. R., of three feed-water heaters manufactured by the Feed-Water Heater Co., of St. Johnsbury, Vt., with the following results: "Three heaters on engines drawing light two and three-car passenger trains 350 miles per day for ten days, connected, and same disconnected, show a total saving of 20,090 pounds of coal, or an average of nearly 700 pounds, which is equivalent to 17 per cent. of fuel saved per heater per day."

A RAILROAD is projected from Niagara Falls along the foot of the cliffs on the American side to the whirlpool; a man has circumnavigated the whirlpool in a barrel and will soon perform a similar feat with the Falls; visitors have access to the American fall without paying toll; the bridge fare to Goat Island has been reduced to 25 cents; and the hackmen are so sweet-tempered and obliging that they carry people around for the merest pittance. If this kind of thing keeps on, the great cataract will get to be too tame and commonplace to be classed any longer among the seven wonders.


FORM 1.
New York Lake Erie and Western R.R.
Michigan Central R.R.
Illinois Central R.R.
Lehigh Valley R.R.
Northern Pacific R.R.
Boston New York and Philadelphia R.R.
New York Chicago and St Louis R.R.
Chicago and Atlantic R.R.
Proposed M.C.B. Standard.
Chicago and Alton R.R.
FORM 2.
Missouri Pacific R.R.
Pennsylvania R.R.
Pittsburgh Fort Wayne and Chicago R.R.
New York Central and Hudson River R.R.
Philadelphia and Reading R.R.
Buffalo Rochester and Pittsburgh R.R.
FORM 3.
Wabash R.R.
Flint and Pere Marquette R.R.
Boston and Albany R.R.
Chicago and Eastern Illinois R.R.
Chicago Rock Island & Pacific R.R.
Baltimore and Ohio R.R.
Chicago, Burlington & Quincy R.R.

CENTRE PLATES.

Center Plate of Proposed M. C. B. Standard Freight Truck; also Twenty Center Plates now in use on as many different roads.

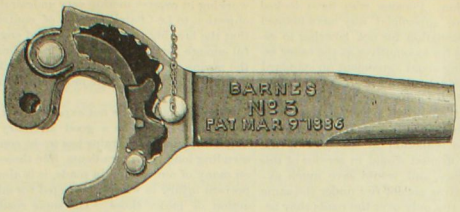


Fig. 1.

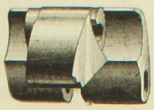


Fig. 2.

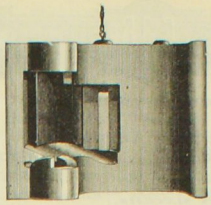


Fig. 3.

BARNES' AUTOMATIC HOOK COUPLER.

The cuts illustrate a new car coupler of the vertical hook type, which is known as the No. 3 Barnes, and which was invented by Lucien Barnes, assisted by Chas. O. Barnes, both of Syracuse, N. Y. In this, his last and best effort, Mr. Barnes has invented a hook which has none of the outs and all of the ins of its predecessors of the same type. Its shape and general appearance are quite similar to others of its kind, with the exception that the locking arrangement is entirely hidden and there are absolutely no springs to give way and get out of order, every thing working by gravity. A very strong point in its favor is that it falls open automatically as soon as released and so does entirely away with any necessity for a train man to ever go between the cars. An old-time principle of the country gate that would not stay open was followed by the inventor and hence the simplicity which is always synonymous with all our best inventions.

In the Barnes coupler the jaw is locked by means of a piece swinging round a pin placed in the right side of the head of the coupler, the jaw pin being placed on the left-hand side. This locking piece rises as it swings round, and, consequently, has a natural tendency to swing forward and lock the tail end of the jaw. This, however, is similarly hinged; *i. e.*, as it swings back its lower edge rests on inclined planes, which compel the whole jaw to rise. In this respect it differs from other couplers of the vertical plane type, in some of which the jaw requires to be swung open by hand to be set to couple, and in others it is made to fly open by a spring.

The locking piece can be swung back and raised by a chain attached to the back of the locking piece. Directly the chain is raised the jaw swings open and the cars are uncoupled. If it is desired to set the cars not to couple, the lever moving the locking piece is simply left hooked up. If, on the other hand, the locking piece is raised, and the lever let fall immediately, the jaw will open and the locking piece fall behind it, ready to lock it in a coupled position whenever the jaw is forced back. When the cars are brought together again, the jaw is driven back and its tail end striking the locking piece, the latter rises and falls again immediately. The locking piece is so arranged that if the cars are run together on a curve, the jaw, which is not then forced completely back, is retained by a small projecting piece on the locking piece, which engages in a sort of step or recess on the tail end of the jaw, clearly shown in Fig. 2. This is sufficient to lock it, the bearing surface in contact being 1⅛ in. wide, but the coupling face of the jaw is not quite at right angles to the line of draft. When, however, the cars move on to a piece of tangent, the jaw is forced completely back, slightly raising the lock again; the lock then falls again and locks it completely.

In the accompanying illustrations, Fig. 1 is a plan of the coupler, part of which is broken away to show the manner in which the locking-piece engages the tail end of the jaw. Fig. 2 is a view of the jaw, the tail end being nearest the spectator. Fig. 3 is a front view, showing the mouth of the coupler, the jaw being removed. The inclined planes up which it rises in swinging are very clearly shown. Fig. 4 is a front view, with the jaw in position.

This coupler is the only self-opener in the world, and consists of but two pieces of cast malleable iron (the jaw and lock piece) aside from the draw-head, which all couplers must have in some form. These pieces, together with the draw-head, are all just as they come from the foundry. The pin in the jaw is 1⅛ in. thick. A ⅝ pin does for the lock and it is a small matter to put it in working shape. Another point in which this coupler is original is in being able to allow more slack than any other hook of its class. In the first pair one inch was allowed, and it was claimed that even three inches could be had if desired. This being the case, much of the prejudice heretofore existing against vertical hook couplers on account of their having no slack would seem to be done away with. The coupler can be applied to a car at a less cost than any other of its class.

The Delaware & Hudson Canal Company and several other roads are at once to give this coupler a thorough test, and much interest is manifested among railroad men in the result. The Barnes Automatic Car Coupler Company, 125 Powers block, Rochester, N. Y., are the owners of the patent.

A So-Called Accident at a Way Station.

A monthly journal is not, for obvious reasons, a suitable medium of current news even in the matter of railroad accidents, the most of which are duly chronicled in the daily papers. But there are exceptional cases like the deplorable occurrence on the morning of July 17, at the South Elizabeth (N. J.) station of the New York division of the Pennsylvania Railroad, the circumstances of which call for more than a passing notice, as an illustration of the way in which heedless people are permitted to expose themselves to danger and death at a passenger station of a great trunk line road, noted for the superior excellence of its track and equipment, the completeness of its train and station service, its block system and precautions against accidents at grade crossings.

The affair at South Elizabeth was what may be called a station accident, the particulars of which are as follows: The station is comparatively a small one. In front of it are two main tracks and two side tracks. The space between the station and the tracks, and also between each of the tracks, is smoothly planked. A number of people were, as usual, waiting to take trains in each direction, and among them a young woman who was accustomed every morning to take a local train to Rahway, a few miles further west, the train running on the west-bound track. Seeing her train approaching, she walked out to the east-bound track to board it, carrying a spread umbrella to keep off the rain. A Western express train, overdue and running fast, was at the same time approaching on the east-bound track. The steam from a freight engine, standing on one of the side tracks, was blown by the wind across the other tracks, and somewhat obscured the view in the direction of the express train, which was then near at hand. The calls and shouts of the people in the vicinity, as soon as they saw her danger, and also on the Rahway train, which had apparently slowed up, only increased the young woman's bewilderment. At this critical moment Mr. Jesse J. Catlin, trackmaster of the road at Jersey City, but who lived in Elizabeth, came out of the station house, took in the situation at a glance, rushed toward the imperiled victim and heroically tried to pull her off the track. He was too late, however, the express locomotive striking them both, killing the young woman instantly and fatally injuring Mr. Catlin.

We need not speak of the personal qualities of the victims, the suddenness of their taking off, or the anguish of relatives and friends. But we would suggest whether this horrible so-called accident, which is only a specimen of its class, can properly be regarded as a mere happening for which only the victims are to blame. Must the safety of people who gather at way stations to take trains, many of them as thoughtless and as ignorant of the perils of train movements as this woman unquestionably was, be left to their own prudence? Does the responsibility properly rest with them and nowhere else? The station operator knew, or ought to have known, that the express train was near at hand and behind time, and yet it seems that the train and station regulations made no provision for the protection of people at the station, but allowed a lightning train to approach so near with unchecked speed, that the lives of people upon the numerous and perfectly accessible tracks were exposed to imminent hazard. It is time that more effective means were made use of for the protection of people in getting on and off trains at way stations like the one at South Elizabeth, and on a four-track road like the Pennsylvania. Such protection is entirely practicable, as is proved by the experience of European roads, and it is difficult to see why the Pennsylvania Railroad Co. is not morally and justly responsible for the shocking sacrifice of life which occurred as above described.

New Elevated Railroad Locomotive.

The mechanical department of the New York Elevated Railroad have recently designed a new locomotive for service on the road. This engine is intended as the heaviest standard, and was designed with a view of handling the five-car trains now run during commission hours. A modification of the Belpaire fire-box is used, but the outside shell, while kept flat, is not sloped in a way that might restrict the steam space. The only woodwork used about this engine is the boiler lagging and the cab window linings. Steel is used for every piece and casting where its application could reduce the weight. Steam chest casings and dome casings are steel castings, and the diamond truck castings are mostly of steel. The fire-box and grate area have been increased, and the boiler has got 154 tubes 1¼ inch diameter, that being 22 more than the other boilers.

The cylinders have one inch more diameter than the other engines, and in working order the engine is one ton heavier. One engine of this type was built at the company's shops at Ninety-eighth street, New York, lately, and is now in service. A very close record of her performance has been kept. She is doing the work on 29 pounds of coal to the train-mile, and is evaporating 7¼ pounds of water to the pound of coal. The link motion is new, and was designed by Mr. John D. Campbell, general foreman of the shops, who schemed it to give as nearly as possible equal distribution of steam for forward and back gear.

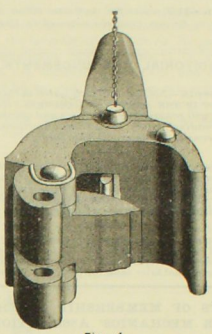


Fig. 4.

The New York State Car Coupler Tests.

The following is the decision of the New York Railroad Commissioners on the car coupler tests made at East Albany, June 16 and 17:

1. That the standard height of draw-bar of the Master Car-Builders' Association, viz., 2 ft. 9 in. from top of rail to center of drawhead, when the car is empty, be adopted by all railroad corporations; that new cars be made to conform thereto, and that old cars, when repaired, be made to conform as nearly as possible.

2. That all freight cars not having platforms be equipped with "deadwood" blocks to conform to the standard of the Master Car-Builders' Association.

3. That a standard link be adopted of 10½ in. inside measurement and 13 in. outside measurement.

4. That all existing links and pin draw-heads be provided with a stop in the throat to prevent a link entering more than 7 in.

5. Of the couplers presented to be tested on the 16th and 17th of June the Board finds the following to fulfill the requirements of the law. There are many others of which the Board has drawings or models, and which possess merit, but as to them the Board makes no mention for the reasons, first, that cars were not equipped with them; and, second, that little weight can be given to the workings of a model alone. Those practically tested are divided, first, into classes mentioned in what the Board regards as the order of merit; second, each coupler is mentioned under its class, in what the Board regards as its order of merit.

First Class A.—Link and pin couplers, pin held up by catch or dog. The dog is thrown back by a link entering and allowing the pin to drop automatically; uses standard link and couples automatically with the old draw-bar with stop in throat, or B, beveled pin, permitting pin to slip under. Hoag; McKeen; N. Barr; Perry; United States; Robinson; Keeler; Sherman; Thurber; Whitman; Kilmer beveled pin; Wilson beveled pin.

Second Class—Vertical hook and link, link pushed on to hook, couples automatically with old drawbar with stop in throat. Archer; Aikman; Marks; Smith; Baldwin; Feunell.

Third Class—Janney; Barnes; Cowell; Thurmond; Dowling; Hein; Titus & Bossinger; Boston Automatic; Lorraine.

Fourth Class—Ames; Curtis & Wood; Adams, Felthausen & Lautenslager.

WORK on the new shops of the Maine Central road, at Waterville, Me., will be immediately begun and pushed forward as rapidly as possible. The shops will cost about $100,000, and the tools and machinery with which they will be furnished will probably cost as much more.

American Street-Railway Association.—The report of the fourth annual meeting of the association, which was held in St. Louis in October last, makes a bulky volume of 200 pages, and is embellished with an excellent frontispiece portrait of Mr. Calvin A. Richards, president of the Metropolitan Street Railway of Boston, and president of the association for 1884–5. The present membership comprises 139 street-railway companies, located in 80 cities in the United States and Canada, which indicates that the growth of the organization has been steady and rapid since its formation in December, 1882. The report contains what appears to be a full report of the discussions, also the reports of committees, and a large quantity of collateral matter in the shape of correspondence, dinner speeches, etc., all bearing more or less directly upon the various details pertaining to the construction and management of street railways. The report of the committee on Diseases of Car Horses and their Treatment is very elaborate and exhaustive. The committee on Electricity as a Motive Power, after tracing the progress that has been made in this branch of scientific research, expresses the opinion that the application of electricity to the propulsion of street cars is entirely feasible, the only question to be settled being its economy, as compared with horse and cable power. The report and discussion on the subject of cable propulsion will be read with interest, the committee expressing the opinion that companies carrying over 5,000 passengers per day, on heavy grade lines, will find it advantageous to change from horses to cable, and that level roadways should carry double the number to reap the same advantage. The next regular meeting of the association will be held in Cincinnati, October 20, 1886.

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ANGUS SINCLAIR, }

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock, construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

BENEFITS OF MEMBERSHIP IN THE MASTER MECHANICS' ASSOCIATION.

We were recently urging a young master mechanic to join the Master Mechanics' Association, and he raised the objection that they had already discussed all the subjects worth investigating; and he also expressed the opinion that the work done was of little value since the association had failed to establish standards for railroad machinery. A man who imagines that the Master Mechanics' Association has finished its work, or believes because a subject has been already investigated that no more light can be thrown upon it, has a very restricted view of the possibilities of improvement in railway appliances. We shall not assert that a man of this caliber is likely to prove a failure as the head of a mechanical department, but we believe the fact of his holding such opinions is a good reason why he should attend the conventions where, by the friction against other minds, he would get the rust of ignorance and prejudice rubbed off his own intellect. It is the fashion on a few roads to depreciate the work done by the association, but it is noticeable that the most intelligent officers even on these roads keep files of the annual reports convenient for reference, and contrive to glean points therefrom not to be obtained elsewhere. The complete reports of the Railway Master Mechanics' Association form volumes of railroad mechanical literature more valuable than any thing else in this line ever collected, yet the reports and discussions at the annual meetings represented by these reports, reflect but a small portion of the information collected by the members in attendance who are anxious to regulate their own practice with the light of experience gained by others.

Since the Master Mechanics' Association was instituted the members have done very valuable services to railroad interests by working out the development of railroad machinery. We fail to find work of equal value done towards the interests they represent by any other technical society. Twenty years ago the country was full of nondescript locomotives representing great diversity of views as to the proper design for ordinary train service. This diversity has been worked down to a few leading types, a most important arrangement and productive of incalculable economy in first cost and repairs. The engines have been changed from wood to coal burners, and every month witnesses new improvements introduced to increase the heat utilized. Standard screw-threads and precision gauges have been adopted by all locomotive builders and leading railroads, nearly all builders are producing work that is strictly interchangeable, and many railroad shops are working into the same money-saving practice. The progress in these lines of improvement has been urged onward and accelerated by the stimulating influence of free interchange of sentiments provided for by the annual meetings of the Master Mechanics' Association. But for the work of this organization there is little reason to question that our railway machinery would to-day be in the chaos of diversity common to railroad machinery in all other countries where societies of railway mechanical superintendents authorized to promote uniformity are conspicuously absent.

The constant agitation in favor of uniformity and standards for car construction carried on by the Master Car-Builders' Association, which, by the way, is principally composed of master mechanics, has led to some misapprehension about the necessity of common standards for locomotive construction. Persons who have looked into the subject in the most superficial way have blamed the Master Mechanics' Association for not laboring to establish common standards for locomotives as the other association is striving to bring about agreement on standard cars. But the cases are widely different. Cars are often loaded at one ocean and discharged at the other. The service they are employed on often keeps cars more on foreign roads than they are upon the roads they belong to. A standard car, or the reduction to standard of the parts that require repairs oftenest would in service of this kind be a great convenience, and would save much expense and delay. Locomotives are not run under the same conditions as cars. They run only over the roads they belong to. If a road has its own engines down to standards it is of little consequence whether or not the parts are of the same dimensions as those adopted by any neighboring road. There would be a saving in first cost, and in parts that have to be purchased manufactured, if a common standard existed for all locomotives of the same general size, but the inheritance of different roads makes the establishing of such standards impracticable. In arranging their working standards, roads have generally followed the style of locomotive that suited them best, using some builders' engine as a model. Other roads had a number of different makes of locomotive, and they had to devise a standard engine that would by little alteration cover as many of the engines as possible. Not a small portion of the good work done at the master mechanics' conventions has been managed by quiet private consultations where members proposing to make changes on their machinery would obtain information from those who had already done the work. Obtaining experience by failure is grimly instructive, but the ordeal is often very expensive to railroad companies. The young master mechanics who attend the conventions and do not presume that they are too near perfection to learn anything from their seniors, avoid many pitfalls by profiting by the experience of those in advance of their own practice. The man who goes to a convention and fails to follow the Socrates practice of asking questions, misses valuable instructive opportunities. If he goes there for the purpose of criticising the proceedings, he may find many imperfections. During public discussions he may note that members occasionally contradict themselves and hold diverse views on subjects that ought to admit of little difference of opinion. If he looks for strictly logical conclusions in reports he may be disappointed. But there is no denying that the views expressed are generally sturdily vigorous and independent, and that sound practical sense is a leading feature in all discussions. If the reports are not literary masterpieces and occasionally limp in their logic, they generally relate facts that are useful to the man searching after knowledge.

THE LE CHATELIER BRAKE.

At the Boston meeting of the Master Mechanics' Association there was considerable mention made of the Le Chatelier brake during the discussion on driver brakes, but it could be understood from the remarks made in the convention, and, better still, from the conversations around, that many of the members had quite vague impressions about the functions and operation of the brake, while others had never heard of it before. Yet this was one of the first power brakes successfully applied to reducing the speed of trains.

Over thirty years ago, M. Le Chatelier, then mechanical superintendent of a leading French railway, conceived the idea of restoring to the locomotive boiler the heat developed by the work of stopping a train. It is well known that the great amount of mechanical energy represented by a heavy train in rapid motion is converted into heat by the action of the brake shoes when the train is stopped by the brakes. The work thus converted into heat is nearly the measure of the energy expended by the locomotive in forcing the train from a state of rest to the ordinary running speed. The problem of devising the means of saving this heat for use in a new cycle of work seemed well worthy of solution. M. Le Chatelier proposed using the ordinary cylinders of the locomotive as a means of stopping the train, and he aimed by the action of the pistons to compress vapor and force it into the boiler at high tension, where it would be stored till the train was ready to start. He led a small pipe from the water covered part of the boiler to the neck of the exhaust pipe. When the necessity for stopping arose, the engineer reversed the engine and opened the water jet. This jet supplied a moist vapor, which was drawn into the cylinder at one stroke, and during the return was forced compressed into the boiler, the work of forcing this vapor representing the retarding action on the train. Like many other well-laid schemes, the idea of returning the mechanical energy to the boiler did not work so well as the inventor anticipated, but the plan of supplying water or vapor to the cylinders saved the rubbing parts from damage when the engine was working in reverse motion, and the reversed engine did braking work without injury to itself. When an ordinary locomotive is running reversed, the piston during one stroke draws in hot air mixed with cinders from the smoke-box. The hot air licks up the lubricants, and the cinders act like emery between rubbing surfaces, producing effects that render working in reverse motion very undesirable. The greatest objection to Le Chatelier's plan of controlling trains was that the braking power of a reversed engine is not powerful enough for quick stops. A good brake must provide the means of stopping a train much quicker than it can be put into high speed by the most powerful locomotive running.

When too much was not expected of it, the Le Chatelier brake was found to be a good auxiliary to train brakes. When the motion of trains has to be controlled while descending long, steep gradients, like those that are common on many of our mountain roads, it is almost impossible to prevent injury to wheels subjected for miles to the heating action of brake shoes. On some roads tires have frequently been loosened from the wheels so that they slipped off, causing serious accidents. In other cases the hot wheels, suddenly coming in contact with snow or water, have broken to pieces. Any thing that will relieve brake shoes of the arduous work they have to do on grades of this kind is calculated to lessen the danger of operating mountain roads. As the Le Chatelier brake acts as a retarder only through the connecting rods of the engine, it readily recommended itself to American railroad men as a valuable aid to other brakes more powerful for ordinary purposes. The Denver & Rio Grande Railroad Company were the first in this country to apply the Le Chatelier brake to their engines, and it is known there as well as on other roads as the "water" brake. It worked so well on that road, and gave so little trouble, that it has been brought into use on nearly all railroads operating mountain gradients of any considerable length.

The brake might, we believe, be applied to advantage in many places where it has not yet been adopted. We believe that every locomotive ought to be equipped with a power brake acting on driving wheels and tender, and that the roads which are not working in this direction are losing money by their conservative or neglectful policy, but where driver brakes are not adopted, the Le Chatelier brake might be applied with advantage. To apply it only costs a few dollars that would quickly be saved by reducing wear of valves, seats and piston packing, especially with switching and other engines that are constantly pulled over to stop the trains they are handling.

THE BURLINGTON BRAKE TESTS.

We shall not attempt to give any detailed account of the trials thus far made, for the reason that they are mainly preliminary and the results as published entirely unofficial; and even if the reported results were perfectly reliable and free from error, they would afford very imperfect data for forming a judgment as to the final outcome of the trials. The progress made is reported to be very satisfactory, although attended with sundry drawbacks incidental to hasty preparation on the part of some of the competitors.

There are five brake companies represented, each providing a train of fifty cars equipped with its brake apparatus. The cars of the American company are new, averaging 27,500 lbs. weight, and marked 40,000 lbs. capacity. The Eames Vacuum cars are new, averaging 21,000 lbs. weight, with 40,000 lbs. capacity. The Rote brake cars are also new, average weight 24,000 lbs., capacity 40,000 lbs. The Westinghouse cars are old, average weight 24,000 lbs., capacity 40,000. The Widdifield & Button cars are also old, average weight 21,000 lbs., capacity 40,000. Four-run trial tests were made with engines equipped respectively with Westinghouse, Eames and American brakes applied to driving-whee's and tenders only, with dynamometer car attached. Hand-brake tests were also made with trains of 25 cars, 12 of which were loaded and 13 empty, followed by gravity tests for determining the friction and resistance of the trains in ordinary running.

The *Railroad Gazette* prints a special dispatch from Burlington, dated on the evening of July 21, which says:

"The results of the last four days' tests of 50 empty car trains are highly instructive and important. The Westinghouse, the Eames and the American were the only competitors. It seems plain that emergency stops will all cause violent shocks, approaching the shock of a collision in the rear third of the train, in the middle much less violent, in front not felt at all. The vi lence increases faster than the square of number of cars. Both air brakes cause only one shock, the buffer brake causes from four to ten, mostly of less violence.

"The American brake showed finely on 25-car tests, giving quick and smooth stops, but admits that 50-car stops are impracticably violent, and this brake practically withdrew to day from the 50-car runs with brakes on every car. It is now probable that tests of 50 cars with brakes on the front 30 only will be made for all five competitors.

The motion at the rear end indicates that it would be probably much better to graduate the air-brakes, so as to insure moderate motion in the 50th car. Working stops with appliances to measure violence will be tested hereafter. There has been considerable breakage after all emergency stops, and these stops will be necessarily abandoned, as all the cars would be soon unfit for service."

The labors of the committee, under the direction of its chairman, Mr. G. W. Rhodes, of the C., B. & Q. road, are highly commended for the fairness and thoroughness with which the details have been arranged for an experimental investigation that will be a landmark in railroad progress. The programme is an extensive one, and a good deal of time will necessarily elapse before the final results are reached. But the facts that are likely to be demonstrated will be worth the cost of getting at them. Some-

thing will be known to a certainty in regard to the comparative merits of the several brake systems that have entered the lists, and the knowledge will go upon the record as a permanent acquisition. It is a business affair strictly, superseding mere assertion, claims, flattering testimonials, and all that, and we feel confident that no injustice will be done to any of the parties in interest.

SOME PERTINENT QUESTIONS.

There is one very important matter in connection with the railroad strikes at the West, and especially the recent switchmen's strike in Chicago, that should attract the attention of every honest and law-abiding citizen in the land. We refer to the inefficiency of the local authorities in suppressing lawlessness and mob violence. If the scenes that were witnessed at the Lake Shore terminus and in its immediate vicinity for days together, are to be repeated in Chicago and elsewhere whenever a strike is organized and carried into effect, some very important and vital questions will come to the front—questions affecting the entire business community, and even involving the stability of the government itself, viz.:

Is railroad property entitled to the protection of law, the same as the property of other incorporated companies, and of individuals and firms?

Are the sworn officers of the law, governors, sheriffs and the heads of police departments, whose duty it is to suppress violence, protect persons and property and preserve order, at liberty to abdicate their functions for fear of incurring the displeasure of a mob which can cast votes on election day, as well as cripple engines, derail trains, destroy bridges and break people's heads when a strike is on?

Must each railroad company establish and maintain an arsenal as an indispensable terminal facility, and keep on duty a corps of armed men to protect its property and save it from wanton destruction?

Is the business prosperity of great cities to be interrupted, the movement of railroad freight brought to a stand-still, and a reign of disorder and confusion inaugurated, because a lot of striking malcontents want half a dozen men discharged from employment who don't belong to the "union"?

If these freight trains, which the local civil authorities are unwilling or incompetent to protect, were loaded with mail matter, imported goods in bond, supplies for United States troops, or other government property, would the pleasure of the strikers have to be ascertained before a wheel could be allowed to turn?

These are pertinent questions, and point to the necessity of a civil service reform that will impress upon state officials that they are not chosen to enjoy the profits and pleasures incident to the positions they disgrace, or to encourage and connive at lawless aggression upon railroad property, lest the aggressors should take it into their heads to get even with them at the next election.

ELECTRIC PROPULSION OF STREET CARS.

An interesting report on the progress of electricity as a motive power was made by a committee of the American Street Railway Association at its annual meeting in St. Louis last October. The report traces the development of the mysterious agent from the time of Thales of Miletus, a Greek philosopher, down to 1885, and covering a period of 2,500 years, beginning with the phenomenon observed by Thales while rubbing a piece of amber, and ending with the Bentley-Knight system of propelling street cars by electricity, a trial of which has recently been made in Cleveland. The researches of the committee, although a valuable addition to this branch of scientific lore, do not seem to be attended with any very important practical results, leaving off as they do just about where they began so far as street cars are concerned.

The horse-car lines represented in the association have more at stake in the ultimate success or failure of electric motors than any other class of investors, for the reason that the use of horse power for transporting people on railway tracks smacks too much of the old by-gone stage-coach era. It does not harmonize with the spirit of the age, and ought to be superseded without unnecessary delay by something less cumbersome and costly, and a great deal more effective. This will doubtless be admitted by shrewd and enterprising managers of horse-car roads, but neither the report of the committee nor the discussion which followed is very encouraging in the matter of electric motors, although the committee say that electric propulsion is "entirely feasible," which means, probably, that electricity can be made to haul cars, and actually does haul them on street surface lines with ordinary curves and grades. Why, then, don't the electricity keep on doing it more and more until the horses disappear? Why so many parade performances, newspaper announcements and extravagant and high-sounding claims? Are the rival electric companies waiting to pool the patents or get the stock satisfactorily distributed?

There is evidently a hitch of a serious nature somewhere. A letter from a representative of the Bentley-Knight system is published with the report, full of glowing promises, claims and guarantees, and an offer is made to furnish estimates of cost and answer any questions that may be asked. The discussion of the report, however, reveals the fact that this particular system, after fifteen months trial, is not satisfactory. The reasons are not very clearly stated; but, so far as can be gathered from the tenor of what was said, the real trouble seems to be in the cost of the electric systems as compared with horse and cable power. Every question as to this point failed to elicit any definite replies based upon detailed and reliable estimates. The fair conclusion would seem to be that the electric propulsion of street cars is in a state of suspense; and that there is nothing to do but wait for further developments.

Coupling Links.

A correspondent wishes to know if the Car-Builders' Association has ever adopted or recommended a standard form of coupling link with standard inside length and width. In reply, we would say that, so far as the records show, no such standards have been adopted or recommended. A report was made by the committee on drawbars in 1879, in which it was recommended that links should be 10 inches long inside, and made of D-shaped 1¼-inch iron. No action, however, was taken on the report. At the special meeting at Niagara Falls, in October, 1882, a committee was appointed to recommend a standard form and proportions for links and pins, but no report was made at the June meeting in 1883, in consequence of the death of Howard Fry, the chairman of the committee, nor was any new committee appointed.

The New York Central road has adopted a standard link and pin, the forms and proportions of which are shown in the Car-Builders' Dictionary. The inside of link is 10 inches long and 1¾ wide, and it is possible that some other roads may have adopted the same dimensions. The diversity in the length of links, however, is very great, ranging from 12 to 16 inches over all, and there is also great variation in the space allowed for the link to move back, and distance from center of pin-hole to face of draw-head.

THERE is just now quite a breezy activity in car building. The activity has been on the increase since the beginning of the year, and the present state of things contrasts most favorably with the long period of depression which began in 1883. Both road and contract shops are, with a few exceptions, full of work, and the orders already booked, when reinforced with the new ones that are pretty sure to come, will make business brisk until the close of the year and perhaps longer. The orders in hand include all sorts of cars for a large number of roads. Important additions are being made to the passenger equipments of several leading lines, including some heavy orders for sleeping and drawing-room cars to be delivered within the next four or five months. There is also an active inquiry for street cars, and the demand for locomotives is said to be twice as good as it was a year ago. Considering the drawbacks incident to the strikes and labor agitation, the present outlook for railroad business is quite as promising as the most sanguine could have predicted a few months ago.

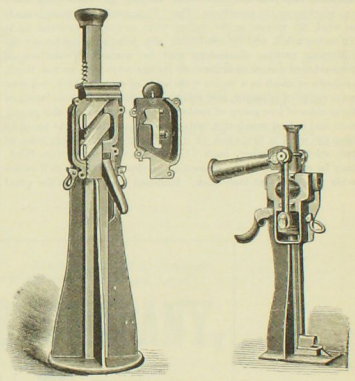
THE directors of the New York Central & Hudson River Railroad have accepted the very liberal proposition of Mr. Cornelius Vanderbilt to construct and furnish a building for the use and benefit of the employés of the company, the building to be located upon ground set apart by the company in the Grand Central depot yard at the corner of Madison avenue and Forty-fifth street, New York. Plans have been prepared by Mr. Vanderbilt for a building 80 feet front by 40 feet deep, which will be a substantial structure, with bath-rooms, gymnasium and bowling alleys in the basement; reading room, library, room for games and offices on the first floor; a large hall for general meetings and rooms for classes on the second floor, and rooms for janitor's family and sleeping rooms for men coming in late or detained in the city over night in the upper story. The proposition is designed to show in a marked way the personal and constant care of the management in all matters which will interest and benefit those engaged in every department of the company's service, including its leased and affiliated lines, as well as the New York, New Haven & Hartford, and of such other companies as may be entitled to use the Grand Central Depot.

THE article we print from the *Northwestern Lumberman* contains some information in regard to car sill lumber which will interest car builders, although it may not be very new or startling. The steady advance in the price of Norway sills is evidently due to the increased demand for cars, but at the same time it is equally evident that prices would range some 30 or 40 per cent. below current quotations, if sills could be sawed beforehand and kept in stock at the mills for quick delivery. There is such a variety of sizes for sills that nobody knows what is wanted until the specifications are given out. This is only another illustration of the kind of economy which results from diversity. Not that all sills for any particular class of freight cars for every road can be reduced to uniform dimensions, but it certainly seems practicable, by concerted action on the part of the roads, to reduce the diversity to such an extent as to make it an object for mill operators to keep in stock certain specified sizes, the effect of which would be that cars could be built at shorter notice and at less cost.

IN the notes of couplers appended to the report of the New York State Coupler Trial, printed in our last issue, it was stated that the pin, like the rest of the Powell coupler, was made of cast steel. This, we are informed, is an error, the entire coupler being made of malleable iron instead of steel. We make the correction at the request of a highly responsible party; but we are, at the same time, somewhat skeptical in regard to the utility of malleable iron as a material for coupler-pins. The idea is new to us.

IN a brief notice of the Baldwin coupler, in our last issue, it was said that a similar device was patented by Mr. Cowell, the inventor of the Cowell coupler, in 1874. This is emphatically denied by Mr. C. H. Warren, the Manager of the Baldwin Coupler Co., and we make the correction at his request, and he also requests us to say that the Baldwin coupler was accepted and recommended at the New York State car coupler trial, at East Albany, on the 16th and 17th of June.

THE Gilbert Car Manufacturing Co. have recently completed a new observation car for the Monarch Parlor Sleeping Car Co. It is called the "Yimir," and differs entirely in its construction from an ordinary drawing-room car. Its total length is 66 feet, and it is designed to run during the season between New York and the White Mountains. We expect to publish an illustrated description of it in a future issue.

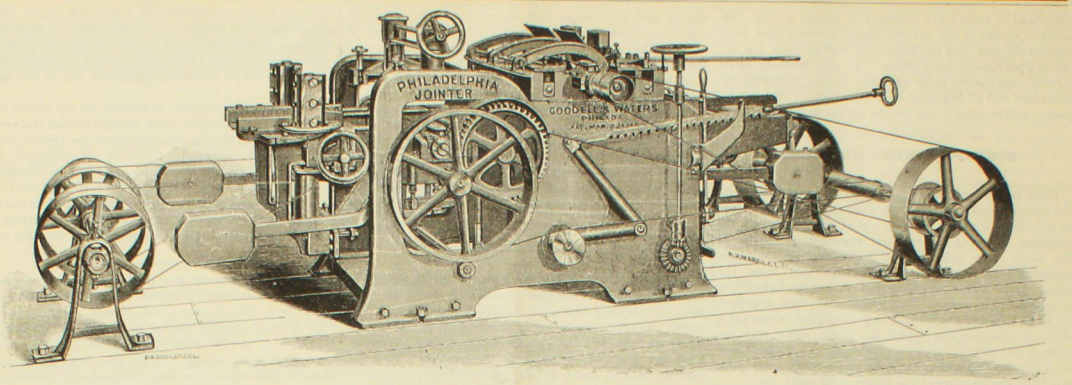


Hawkins' Patent Jack.

In this jack are combined the two mechanical powers of the lever and toggle-joint. When lifting, the simple power is obtained, which is very great, while at the same time, and without increased strain on the lever, this leverage is applied upon the toggle-joint. Although the jack will hoist a weight with threefold greater speed, it is nearly as powerful as the hydraulic. Its safety, both in lifting and lowering weights, is beyond question, for the reason that the power is transmitted from the lever to the ratchet-bar by means of two clutches, the weight being lifted by one and retained by the other. The clutches are solid, having an aperture through which the ratchet-bar passes, and have parallel sides, the ends being diagonal to the sides. Upon the inner walls of one end of each are arranged six teeth, which engage with six corresponding teeth upon the ratchet bar. At the opposite end, and on opposite side of ratchet-bar, the retaining clutch rests upon a lug in the frame, and upon this side also the power is applied to the lifting clutch; so that, by applying the power upon the opposite side of the bar from the teeth, a grip is obtained upon the bar, which would nearly sustain the load without the aid of the teeth, and this grip increases as the weight increases, and when under load it is impossible to disengage the clutch sustaining it until the other clutch has been engaged and relieved it.

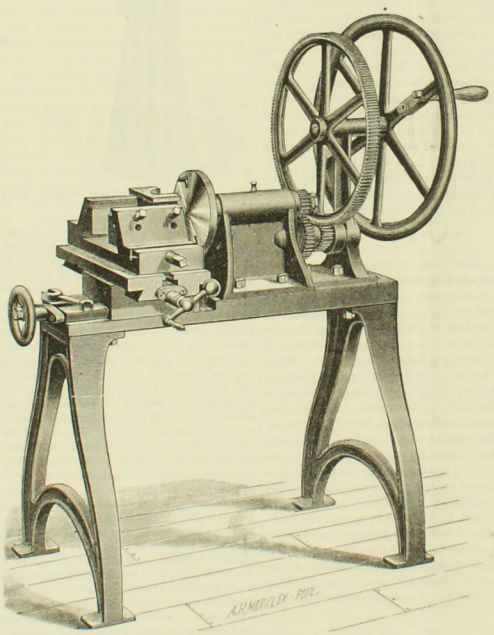
Another feature is, that a weight can be lowered with perfect safety, and lifted in less than one-fifth the time required by the screw jack, and less than one-third of what is required by the hydraulic jack. When a weight is raised to the desired height, the winding of a screw back to its former position, or waiting for the ram to settle back, is avoided by pressing the reversing handle to the left, when the bar will drop instantly. Or, if a weight be elevated, and is to be lowered, the ratchet bar can be raised to its work by the hand instantly. Then by throwing the reversing handle to the right, working the lever the same as when lifting, the load will be lowered with the same speed and safety. In the working of the jack there is little friction, and no wearing or chafing of the teeth. The ratchet bar is steel, the teeth cut out of solid metal, and the step which sustains the weight is solid steel and case-hardened, Manufactured by the Railway Speed Recorder Co., Kent, Ohio.

This company also manufacture a special jack for lifting tracks. This is shown in the small engraving. Its weight is about fifty pounds. It is simple in construction, portable, strong and durable and can be operated and repaired by an unskilled workman. In quickness of operation and other essentials, it is claimed to be superior to any other device of its class now in use.



NEW ENDLESS BED DOUBLE SURFACER AND JOINTER.

For a machine specially adapted to all classes of heavy car and railroad work, there is probably no other in the market to-day which will meet the requirements so well as the one illustrated in the accompanying engraving, and called "The Philadelphia Endless Bed Double Surfacer and Jointer." This machine is fitted throughout with all the latest and most approved appliances, among them the swinging pressure-bars, which have established a pronounced success, and the Goodell patent double rolls, whereby two pieces of timber of varying thickness may enter the machine at the same time. The "Philadelphia" jointer is made to work 26 inches or 30 inches wide, as may be ordered, up to 12 inches thick, and by combining the jointing attachment the following various dimensions may be worked. To surface all four sides of a stick of timber 22 inches wide by 8 inches thick, or down as small as 4 inches wide by ¾ of an inch thick, is a very wide range of capacity, and still more is added. The surfacing of three sides of two pieces of timber at one operation is the prominent and indeed wonderful feature of this machine. At the same time the work is first-class in every particular. Three sides of two sticks of timber, each 11½ inches wide by 8 inches thick, may be surfaced at one operation, or down as small as 3 inches wide by ¾ of an inch thick. Railroad men will see the great utility of this machine, and from its varied capacity it may be justly called a most useful machine. Another andvery ingenious device introduced among the many novelties about this tool, is the roll-raising attachment. Heretofore it was necessary when surfacing long sticks of thick timber to raise up the ends of the timber in order to gain entrance to the rolls; but now, by the application of a very simple and easy-acting arrangement, placed at the infeeding end, this trouble is practically obviated, and no longer is the operator compelled to feed the machine with so much inconvenience. A lever controls the raising of the rolls to the desired height and comes with reach, and in no way obstructing the working of the operator. The jointer spindle frames are very heavily constructed, and are substantial and steady; the spindles are made of the best machinery steel, and run smoothly and without a jar, which is very essential when good work is desired. It is needless to speak of the efficiency of the rotary bed, as their success is so well established and well known to all operators and users of planers. This is just the machine for car and railroad shops, and purchasing agents and officials will do well to correspond with the manufacturers, Goodell & Waters, Philadelphia, and obtain prices and any further particulars and information that may be desired.



Jointer for Facing Locomotive Brasses.

In this age of heavy freight and fast passenger service, it is necessary that all the wearing parts of locomotives should be properly attended to and kept in the best kind of repair. The connecting rod and parallel brasses require considerable attention when kept "brass and brass," as termed, and fitting the crank pins properly there is very little noise and jar. The manner of keeping them true by filing the faces requires a very expert man, consumes a great amount of time, and uses up many of the best files. It is necessary to have the joints or faces of the brasses exactly true with the straps; unless they are so when keyed up, they will wear the straps as well as the brasses and become loose, when straps and brasses both have to be replaced. The machine is designed to do this work by hand or power; it is made light so that two men can carry it to the work; it has an adjustable chuck that catches the brasses same as the strap does and holds it as held on the pin; no more time is required to accurately catch or place the brass in it than to screw up an ordinary vise. When the carriage containing the chuck is brought up to the cutter, a cut from $\frac{1}{1000}$ to $\frac{1}{64}$ of an inch can be taken off. The cutter recommended for the purpose is a single one placed into a disk adjustable to different diameters; it can be quickly taken out and ground on an ordinary grindstone or emery wheel. This is a useful and rapid working tool and will greatly economize this particular kind of work. Manufactured by Pedrick & Ayer, proprietors of L. B. Flanders Machine Works, Philadelphia, Pa.

THE BROWNE & SHARPE MFG. CO., Providence (R. I.), are now employing a few more men than ever before in their experience. The fine prospects of January and February, which so wofully failed in March, April and May, are now returning, and inquiries and orders long deferred, as well as a very large proportion of new ones, are now going on their books.

THE UNION SWITCH & SIGNAL CO., of Pittsburgh, have concluded an arrangement with the Pittsburgh, Virginia & Charleston Railroad, to put in their switching and signaling system on the Southside. They have also contracted with the Rapid Transit Company, of New York, to put up their signals and switches in Harlem.

THE MISSOURI CAR & FOUNDRY CO. have placed all their contracts for the machinery to be used in the rebuilt portion of their works. The 500 horse-power Corliss engine employed in the mill, which they thought would have to be replaced, will be repaired and brought into service again.

JONES & LAUGHLINS, of the American Iron Works, Pittsburgh, will at once rebuild their foundry, which was recently burned. The new building will be fire-proof, and will be 210 feet in length and 104 feet wide.

THE United States Circuit Court for the Eastern District of Michigan has rendered a decision in the case of the Detroit Lubricator Co. against F. Lunkenheimer, for infringement of plaintiff's patent lubricating device. The decision affirms the patent to be valid, and orders payment of profits and damages to complainant.

THE "VOLCANO" heater, manufactured by Collins & Burgie, Chicago, Ill., is expressly adapted to railway depots and way cars, and has won a reputation for utility and economy that is not surpassed by any other device of its class. It is so strongly constructed that in case of a train collision or overturn, it is not liable to get damaged. It is also proof against the carelessness of employés. New roads are adopting it every year, and its popularity is steadily growing.

GEO. M. CLARK & CO., of Chicago, have recently begun the manufacture of railroad lanterns, car lamps, switch lamps, etc., and have adopted some patterns and forms that are particularly attractive. Mr. Clark has long been identified with this class of goods, and his many friends among railroad people will wish him success in his new enterprise.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any errors that may be noticed in our list:

Baltimore & Ohio.—The office of Master of Machinery, heretofore held by A. J. Cromwell, has been abolished. The duties will hereafter be performed by W. H. Harrison, Superindent of Motive Power.

Bodie & Benton.—E. L. Reese has been appointed Master Mechanic.

Michigan & Ohio.—O. W. Bell, recently from the Peoria, Decatur & Evansville, has been appointed Superintendent.

Missouri Pacific.—John Hodge has resigned his position as Master Car Builder, and is now Superintendent of the St. Charles Car Co. at St. Charles, Mo.

New York, Lake Erie & Western.—J. R. Shaler, heretofore Superintendent of the Eastern Division of the New York, Pennsylvania & Ohio, succeeds W. M. Clements as General Superintendent of this leased line, and Chas. A. Brunn succeeds Mr. Shaler as Superintendent of Eastern Division.

Northeastern of Georgia.—This road is now operated by the Richmond & Danville. E. Berkley is Superintendent, and T. W. Gentry Master Mechanic.

St. Joseph & St. Louis.—This road is now operated independently of the Wabash. W. P. Harris is General Superintendent and J. W. Sager is Master Mechanic.

St. Louis, Ft. Scott & Wichita.—Russell Harding has been appointed Superintendent.

St. Louis & San Francisco.—A. P. Mann, Jr., has resigned as Purchasing Agent.

Texas & Pacific.—A. A. Egbert, General Superintendent, has resigned; also F. Mertsheimer, Superintendent of Motive Power. Vacancies not yet permanently filled.

Gentlemen:—

How natural it is to try to get *something* for *nothing*, and expect satisfaction in the use of materials that look well, but have no real merit. This is exemplified in painting cars as much as anywhere. The Perfect Method Paints manufactured by us insure durability and saving of time otherwise lost in repainting, or lost by decay of the wood and rust of the iron when the paint has perished, as most of the ordinary paint soon does.

The Sherwin-Williams Co.

Manufacturers High Grade Paints and Colors for Railway Use. CLEVELAND AND CHICAGO.

Established 1856.

Shipman & Bolen, Mfrs. of fine

Railway Varnishes.

Our Varnishes excel in durability,

Newark, New Jersey.

FINEST QUALITY FIRE BOX AND BOILER PLATES

By the Crucible and Open-Hearth Processes.

HUSSEY, HOWE & CO. [Limited],

PITTSBURGH, PA.

The Oldest Manufacturers of Crucible Fire-Box Plates.

BEST QUALITY TOOL STEEL AND Standard Crucible Spring Steel.

Made Expressly for Railroad Use.

GEORGE WESTINGHOUSE, Jr., President. JOHN CALDWELL, Treasurer.
T. W. WELSH, Superintendent. W. W. CARD, Secretary. H. H. WESTINGHOUSE, General Agent.

THE WESTINGHOUSE AIR BRAKE COMPANY,

PITTSBURGH, PA., U. S. A.,

MANUFACTURERS OF THE

WESTINGHOUSE AUTOMATIC BRAKE.

The WESTINGHOUSE AUTOMATIC BRAKE is now in use on 15,000 engines and 125,000 cars in all parts of the world. This includes 45,000 freight cars.

The WESTINGHOUSE AUTOMATIC BRAKE is the only continuous brake that has been successfully used on freight trains.

THE AUTOMATIC BRAKE will, in consequence of its quick application, stop a train in the least possible distance.

THE AUTOMATIC BRAKE on freight trains, as in passenger service, applies itself instantly to all parts of the train in the event of the train breaking into two or more parts, a feature of great importance in view of the statistics published in the *Railroad Gazette*, which show conclusively that a majority of the collisions are caused by the breaking in two of trains. (See *Railroad Gazette*, Feb. 12, 1886, page 113.)

THE AUTOMATIC BRAKE also applies itself to every car in the train, in the event of any accident to the brake apparatus of such a nature that it would render any non-automatic continuous brake inoperative.

THE AUTOMATIC BRAKE can be applied from the rear or from any portion of the train, if desired.

THE AUTOMATIC BRAKE will effect an increase of at least twenty-five per cent. in the efficient value of freight rolling stock, owing to the quicker time that can be made on the road, and the avoiding of delay at stations and sidings. Freight trains carrying perishable goods are being daily run on passenger schedules.

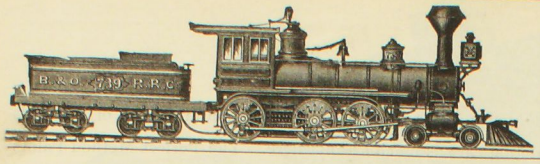
THE AUTOMATIC BRAKE, applied to freight cars, avoids the flattening of wheels and effects a yearly saving, in this item alone, nearly equal to the first cost of the apparatus.

THE AUTOMATIC BRAKE will prevent a greater part of the accidents to freight trains which form so large an item of expense in railway management.

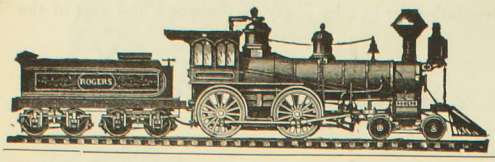
THE AUTOMATIC BRAKE will save employés from the danger and exposure to which they are now subjected, having to ride on the tops of cars in cold and stormy weather, and often sacrificing their lives in the discharge of their duties.

THE AUTOMATIC BRAKE is simple in construction and operation, and cheaply maintained, the working parts being combined in one piece of mechanism.

THE AUTOMATIC BRAKE is not an experiment, but is the result of many years of practical experience, and its capabilities are well known to all railway managers.

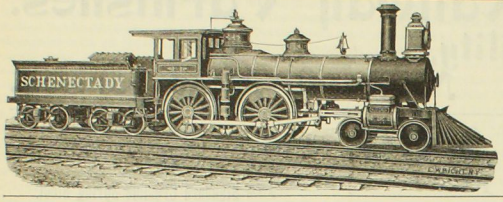


PITTSBURGH LOCOMOTIVE AND CAR WORKS.
PITTSBURGH, PA.
MANUFACTURERS OF
Locomotive Engines for Broad or Narrow Gauge Roads,
From standard designs, or according to specifications, to suit purchasers.
Tanks, Locomotive or Stationary Boilers Furnished at Short Notice
D. A. Stewart, Prest. D. A. Wightman, Supt. Wilson Miller, Sec. & Treas.



ROGERS LOCOMOTIVE AND MACHINE WORKS,
PATERSON, N. J.
New York Office, 44 Exchange Place.
Manufacturers of Locomotive Engines and Tenders and other Railroad Machinery
J. S. ROGERS, President. R. S. HUGHES, Secretary. WM. S. HUDSON, Sup't. PATERSON, N. J.
R. S. HUGHES, Treas., 44 Exchange Place, New York.

RHODE ISLAND LOCOMOTIVE WORKS,
PROVIDENCE, RHODE ISLAND.
EARL PHILIP MASON, Vice-President. CHARLES FELIX MASON, President. ARTHUR LIVINGSTON MASON, Secretary.
WILLIAM P. CHAPIN, Treasurer. JOSEPH LYTHGOE, Superintendent. WILLIAM H. FENNER, Jr., Agent.



SCHENECTADY LOCOMOTIVE WORKS.
CHAS. G. ELLIS, President. EDWARD ELLIS, Treasurer.
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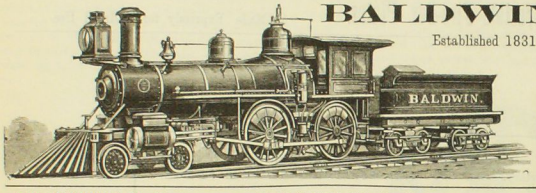

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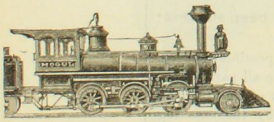

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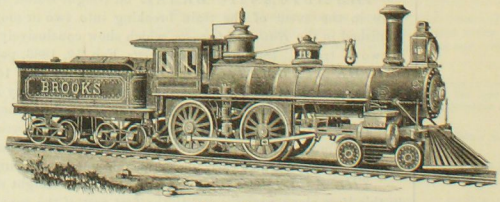

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